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THE HISTORIC AND CURRENT STATUS OF THE MOUNTAIN PLOVER IN MONTANA

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ABSTRACT

We reviewed the historic and recent literature to determine the relative abundance and distribution of mountain plovers (*Charadrius montanus*) in Montana during presettlement, settlement, and recent periods. Notes recorded by naturalists during the presettlement and settlement period indicated that the mountain plover was widely distributed on prairie grasslands east of the Continental Divide in Montana. Three early naturalists associated mountain plovers with black-tailed prairie dog colonies. The relative abundance of plovers was variously reported as rare, not at all common, found at infrequent intervals, regular summer resident, common, and abundant. Two naturalists placed mountain plovers in a short list of bird species characteristic of prairie grasslands. The implications are that mountain plovers were restricted to specific habitats but where these habitats were common so were mountain plovers. Overall, it appears that mountain plovers have decreased in numbers and distribution in Montana during this century. Agricultural conversion of prairie grasslands and prairie dog eradication are likely the two major factors responsible for this decline in breeding area.

We conducted surveys during late spring and early summer from 1991-1997 to locate mountain plovers in Montana east of the Continental Divide. Mountain plovers were found in nine areas and were documented to breed at seven of these sites. Mountain plovers at three of these sites were surveyed annually to gather data on relative population trends, productivity and habitat use. These three sites were ranked as the second through fourth major mountain plover population centers in Montana. (Use of the word population in this paper does not imply genetically distinct groups but instead refers to mountain plovers living within an identifiable geographic region.) Montana's major mountain plover area in Phillips and Blaine Counties was not surveyed because of previous and ongoing work by others in this area. The 3 survey areas were in Northeastern Montana near Glasgow (648 km^2) (ranked as 3rd population), Central Montana near Harlowton (2,565 km^2) (ranked as 2nd population), and a broad region in Southwestern Montana around the Elkhorn, Bull, Highland, and Tobacco Root Mountain Ranges (3,620 km^2) (ranked as 4th population). A total of 441 observations of 1,075 mountain plovers was recorded for the three study areas during all seven years (2.44 birds/observation) for all areas, and 39 observations 63 plovers were recorded in other areas of Montana. Highest non-repeated counts of adult mountain plovers were 43, 118, and 35 for the Northeastern, Central, and Southwestern study areas, respectively. Permanent census transects established in 1992 at these 3 study areas indicated no consistent trend in relative numbers from 1992 through 1997 at the Northeastern and Central Montana study areas and a possible downward trend at the Southwestern Montana study area. Reproduction was documented at 7 of the 9 areas used by plovers with the first brood being observed on 8 June and the last incubating adult observed on 18

July. A total of 147 broods was observed and the average number of chicks per brood was 1.84. Sixty-nine of the broods were downy chicks and averaged 2.04 chicks per brood, 53 broods were feathered chicks and averaged 1.73 chicks per brood, and 25 broods had fledged with an average of 1.48 chicks per brood. Mountain plovers were closely associated with sites characterized by slopes under 5%, vegetative height under 6 cm, and greater than half the soil surface being bare ground or lichen. In the Northeastern study area, mountain plovers generally used bottomlands of broad, low gradient drainages. In the Central and Southwestern study areas, mountain plovers were found on ridge tops and alluvial fans extending from footslopes of mountain ranges. Mountain plovers in the Northeastern study area were associated with dwarf shrub communities (*Atriplex gardneri* and *Eriogonum flavum* habitat types) while mountain plovers in the Central and Southwestern study areas were generally associated with the *Stipa comata/Bouteloua gracilis* habitat type. Use of this latter habitat was restricted to sites intensively grazed by sheep, cattle, and/or black-tailed prairie dogs (*Cynomys ludovicianus*).

INTRODUCTION

The mountain plover (*Charadrius montanus*) is the sole North American member of the family Charadriidae which inhabits grasslands on a year-long basis. During the breeding season, it is found on heavily grazed short and mixed grass prairies of the Great Plains from southern Alberta to New Mexico. Original accounts of this bird indicate that it was common in at least some portions of its range (Bent 1929). Declines in mountain plover numbers noted earlier in this century were attributed to loss of habitat due to agricultural conversion of grasslands and market hunting in wintering areas (Bent 1929). The latter problem has been eliminated but habitat continues to be lost. Presently, the mountain plover is listed by the US Fish and Wildlife Service (USFWS) as a candidate species for listing as threatened or endangered under the Endangered Species Act (Leachman 1997).

In Northcentral Montana, the mountain plover is reported to selectively use black-tailed prairie dog (*Cynomys ludovicianus*) colonies for breeding, nesting, and feeding (Knowles et al. 1982, Knowles and Knowles 1984, Olson 1985, Olson and Edge 1985, Olson-Edge and Edge 1987). Mountain plovers found in this region are associated with prairie dog colonies found in northern Fergus and Petroleum Counties northward into northern Phillips and Blaine Counties. Although this is Montana's major mountain plover population, they do occur in other regions of Montana and are not necessarily associated with prairie dog colonies (Knowles 1985, Skaar et al. 1985, Prellwitz 1993). However, very little is known about these other sites where plovers are found.

We conducted surveys for mountain plovers from 1991 through 1997 throughout Montana east of the Continental Divide (except for Phillips County) to determine breeding areas and habitat relationships. During the first survey year (FaunaWest 1991), we concentrated our survey efforts in areas for which we had historical accounts or recent reports of mountain plovers. Based on information gathered during this initial survey effort, permanent census routes were established in a Northeastern, Central, and Southwestern Montana study areas in 1992 (Knowles and Knowles 1993). All or parts of these areas were surveyed for mountain plovers again from 1993 through 1997 (Knowles and Knowles 1994, FaunaWest 1995, Knowles and Knowles 1996, Knowles and Knowles 1997 and this report). During each of these years, we made an effort to examine previously unsurveyed areas for mountain plovers. This effort even included surveys in potential habitat in southwestern North Dakota, and northwestern South Dakota. In addition to previously known breeding areas, this expanded effort has documented breeding or probable breeding of mountain plovers near Galata, Fairfield, Ingomar, Warren, and Ekalaka, Montana. The purpose of these surveys was to: 1) Determine mountain plover breeding distribution (exclusive of Phillips County), 2) Determine habitat use by mountain plovers,

and 3) Establish permanent census transects through each of the 3 study areas to monitor the relative trend in mountain plover numbers. This report summarizes the results of the mountain plover survey effort from 1991-1997.

DESCRIPTION OF THE STUDY AREAS

Mountain plover trend counts were conducted in three areas of Montana (Figures 1-3). These areas are designated the Northeastern, Central, and Southwestern Montana study areas. The Northeastern study area is located 24 km southwest of Glasgow (Fig. 1) and comprises approximately 648 km^2. Land ownership in this study area is almost entirely Federal and State and includes the entire Little Beaver Creek drainage and portions of Brazil, Sagehen, and Lone Tree Creeks, and Miller Coulee. This study area has extensive bentonite deposits which have been previously mined. The physiography of the area consists of valley bottoms with deeply incised drainages cutting through fine alluvium, gently sloping ridge sides with exposed Bearpaw Shale, and narrow, relatively level ridge tops. Elevation of the study area ranges from 682-804 m.

The valley bottoms in the Northeastern study area tend to be broad (>0.8 km across) and relatively level (<1% slope). The alluvium in the central portion (silty overflow sites) of the valleys frequently occurs as large areas of light colored hardpan. Vegetation on these sites is dominated by Nuttall's saltbush (*Atriplex gardneri*), plains prickly pear cactus (*Opuntia polycantha*), Nuttall's alkali-grass (*Puccinella nuttalliana*) and blue grama (*Bouteloua gracilis*). We refer to these sites as the ATGA habitat type. Within these hardpan areas are hummocks of soil dominated by blue grama. Riparian areas through these bottoms are dominated by silver sagebrush (*Artemisia cana*), and western wheatgrass (*Agropyron smithii*). Generally, there are gentle rises on either side of the valley bottom dominated by almost pure stands of yellow eriogonum (*Eriogonum flavum*) and Richardson's rubberweed (*Hymenoxys richardsonii*). We refer to these sites as the ERFL habitat type. Both the ATGA and ERFL habitat types have an extremely low vegetative height profile (<10 cm) and a high percentage of bare-ground.

The ridge sides in this area are dominated by creeping juniper (*Juniperus horizontalis*), elk sedge (*Carex geyeri*), western wheatgrass, and prairie sandgrass (*Calamovilfa longifolia*) (JUHO habitat type). The vegetative height profile is variable but generally ranges from 10-25 cm. There is a high percentage of bare soil in areas not covered by creeping juniper. Slopes on these sites generally range from 5-10%. Throughout the study area, on both the low rises in the valley bottoms and lower slopes of ridges, there are areas underlain with bentonite. These areas are nearly devoid of vegetation with the exception of lichens, prostrate knotweed (*Polygonum avicular*) and silverscale saltbrush (*Atriplex agentea*) (BENT habitat type).

The ridge tops in this study area are dominated by western wheatgrass, blue grama, and a dwarf form of big sagebrush (*Artemisia tridentata*) (BOGR habitat type). Plains prickly pear is also abundant on these sites. A shallow layer of glacial till covers the ridges and is characterized by frequent areas of rock cobble and hardpan soils. The rock cobble is also found, to a lesser extent, in the valley bottoms and on the ridge sides. Nuttall's saltbush becomes locally abundant in some of these hardpan sites. Overall, this study area has extremely depauperate plant communities.

The Central study area is located along the southern benches of the Little Belt, Big Snowy, and Little Snowy Mountain Ranges (Figure 2) and occupies an area of approximately 2,565 km^2. Land ownership is almost entirely private with the normal compliment of State lands (2 sections per township). The only exception is the eastern portion of the study area which includes some Federal land (Bureau of Land Management (BLM) and U.S. Fish and Wildlife Service (USFWS). The elevation within this study area ranges from 1,098-1,708 m.

The major habitat in this study area is the *Stipa comata/Bouteloua gracilis* habitat type (STCO/BOGR)(Mueggler and Stewart 1980). It is dominated by needle-and-thread grass (*Stipa comata*), blue grama, threadleaf sedge (*Carex filifolia*), and June grass (*Koeleria cristata*). Fringed sagewort (*Artemisia frigida*) is a common sub-shrub in this habitat type, and common forbs include fleabane (*Erigeron* spp.) and tufted milkvetch (*Astragalus spatulatus*). The *Agropyron spicatum/bouteloua gracilis* habitat type (AGSP/BOGR) occurs at higher elevations (1,676 m) and is floristically similar to the STCO/BOGR habitat type except for the scattered occurrence of bluebunch wheatgrass (*Agropyron spicatum*). Vegetative height at heavily grazed sites in this study area are generally less than 10 cm while at ungrazed to moderately grazed sites it ranges from 10-20 cm.

Topographically, this study area consists of broad gravel ridges or benches extending south from the Little Belt and Snowy Mountain Ranges. This topographic situation extends from Haymakers Creek on the west all the way to the eastern terminus of the Little Snowy Mountains, a distance of about 106 km. In some areas, these ridges are poorly defined and appear to be more like an alluvial fan. Where ridges are well developed, they are separated by broad valleys. Ridges, alluvial fans, and valleys in this area are all inclined from 1-2%, sloping southward away from the mountains for a distance of 16-24 km. At the southern margins of the ridges in Golden Valley and Musselshell Counties, soils change from limestone gravels to heavy clays derived from shales, and the topography becomes more dissected by drainages. Three black-tailed prairie dog colonies are located along this transition zone. Approximately 34% of this study area has been disturbed by agriculture.

The Southwestern study area is distributed along the southern portion of the Elkhorn Mountains, either side of the Bull Mountains, the west side of the Tobacco Root Mountains and

the east side of the Highland Mountains. This is an extensive region comprising 3,627 km^2 but less than 1% of the area is used by mountain plovers at a limited number of specific locations. Consequently mountain plovers within this study area are not continuously distributed across the region.

The grassland habitats in Southwestern study area are very similar to the Central study area being dominated by the STCO/BOGR habitat type. The topography consists of gravel benches, ridges, and alluvial fans extending out from these large mountain ranges (2,898-3,203 m maximum elevation). The elevation in areas used by mountain plovers in this study area ranges from 1,403-1,525 m. Overall, the topographic situation in this study area is much more complex and diverse than the Central study area due to the diverse geologic history of this region.

The majority of the land in the Southwestern study area is privately owned at the lower elevational ranges. However, there are some BLM administered lands and State-owned lands in this study area. The dry and rocky nature of this region has limited agricultural conversion of grasslands habitats with approximately 25% of the area being farmed. However, much of the STCO/BOGR habitat type in this region has been replaced with crested wheatgrass (*Agropyron cristatum*) pastures. Black-tailed prairie dogs may have been common in this study area at one time (Cates 1937) but are now limited to a few small colonies.

Mountain plovers are found in 6 other areas of Montana and a brief descriptions of habitats follows. In Phillips and Blaine Counties mountain plovers are found primarily in prairie dog colonies on glaciated plains. Generally, these prairie dog colonies occur in upland prairies dominated by blue grama, June grass and western wheatgrass. Mountain plovers using Froze-to-Death Creek in Treasure County and Lone Tree Creek in Carter County are associated with the Nuttall's saltbrush habitat. Plovers observed on the south side of the Pryor Mountains are using a birdfoot sage (*Artemisia pedatifda*) habitat and Nuttall's saltbrush habitat, and on the west side of the Pryor Mountains they are associated with sites dominated by blue grama. Sites used by mountain plovers in Teton and Toole Counties are dominated by the STCO/BOGR habitat.

METHODS

Surveys for mountain plovers were generally conducted each year during the months of May, June and July (1997 2 May to 14 July) - the time period that mountain plovers are most likely to be observed in Montana. However, the 1991 and 1996 surveys extended into August. Potential mountain plover habitat was found by slowly driving county roads and two-track vehicle trails, and looking for large level areas of short vegetation that was intensively grazed by livestock and/or prairie dogs. Potential mountain plover habitat was carefully examined with binoculars from the vehicle or by walking through the area.

Mountain plover observations were recorded with respect to number, age class, time of day, legal description, habitat, vegetative height, topographic situation, slope, and activity. We also noted if the observation occurred within a black-tailed prairie dog or Richardson's ground squirrel (*Spermophilus richardsonii)* colony, within 200 yards of a stockwater site, if the area had been grazed, and if cattle, sheep or other ungulates were present in the pasture. Mountain plovers were classified as adults, downy chicks, feathered chicks, and immature. An immature mountain plover was a fully feathered chick capable of flying. Locational information of all mountain plover observations are available upon request.

During 1994, 1995 and 1996, physical characteristics of the vegetation at sites used by mountain plovers were measured on an opportunistic basis. A 2x5 dm frame (Duabinmire 1959) was used to measure canopy coverage of grasses, forbs, sub-shrubs, shrubs, litter, and bare ground. The tallest plant in each plot frame was measured and an estimate was made of the average vegetation height within the plot frame. Ten plot frames, each separated by 3 m, were placed in a line across the area mountain plovers were observed to use.

Permanent census stations were established along vehicle routes in 1992 at the Northeastern (70 stations) and Central (90 stations) study areas, and at specific sites known to be used by mountain plovers in the Southwestern study area (see Knowles and Knowles 1993 and FaunaWest 1995 for detailed descriptions of each station location). Selection of census stations in the Northeastern and Central study areas was based on potential habitat and not necessarily where mountain plovers were previously observed. The latitude and longitude of each station were determined with a Global Positioning System unit for each visit from 1994-1997. These uncorrected data were averaged and are available from the authors upon request.

Mountain plovers were counted at the permanent census stations from a parked vehicle (some of the census stations in the Southwestern study area required that we walk to the site). A 10 minute scan of the surrounding area was made with binoculars and a spotting scope. All mountain plovers observed in the vicinity of an observation station were counted and recorded. Due to irregularities in topography and vegetative height, the radius of the survey area around an observation station varied substantially among stations and between study areas. At the Northeastern study area, slight undulations in topography frequently resulted in many "blind spots" within a survey area and at the Central study area, changes in land use (e.g. farmed vs. not farmed, grazed vs. not grazed) within a survey area were common.

Historical records of mountain plovers in Montana were determined by reviewing journal notes and publications of major naturalists to work in Montana from 1850 through 1930. This time span was divided into presettlement (prior to 1900) and settlement (1900-1930) periods. Recorded mountain plover

observations between 1930 and 1989 were summarized as recent records. The breeding distribution of mountain plovers in Montana as reported by Skaar et al. (1985) is based on old records and undocumented recent records (Jim Richel, Natural Heritage Program, pers. commun.). This information has been incorporated into documented plover distribution data in the latest update of the Montana Bird Distribution.

RESULTS AND DISCUSSION

Presettlement Records (1800s)

Based on historic records, the mountain plover was found throughout the shortgrass habitats of Montana east of the Continental Divide (Figure 4). Possibly the first observation of the mountain plover in Montana was recorded during the Lewis and Clark expedition in 1805. Lewis comments about a small curlew or plover not previously seen on the expedition which he observed near the entrance of the Smith River and again in the vicinity of Canyon Ferry. This has been interpreted by Thwaites and Coues to be either a mountain plover or an upland sandpiper (*Bartramia longicauda*) (Burroughs 1961).

The first positive record of the mountain plover in Montana was recorded by Coues, in an 1874(a) report (Table 1). He shows that Hayden collected a mountain plover on 29 May 1860 at Otter Creek, and another on 7 July 1860 at Smith's Fork. Hayden was a member of the Raynolds Expedition in that year (see Knowles and Knowles 1993a). The expedition traveled along the Yellowstone and Missouri Rivers and presumably the plovers would have been collected near the mouths of the designated drainages. Otter Creek is now known as Sweetgrass Creek and empties into the Yellowstone River about 13 km east of Big Timber. The Smith's Fork is the Smith River which meets the Missouri River about 14 km southwest of Great Falls.

Cooper (1869a,b) while visiting Fort Benton during July 1860 reported mountain plovers to be found in "prairie dog villages on the driest plains" in this area. Later in August as he continued his trip up the Missouri River he noted that mountain plovers were rare along the east base of the Rocky Mountains and were "usually about prairie dog villages" (based on our observations, August is not an optimal period for plover surveys). He specifically noted one prairie dog colony on the plains between the Sun and Dearborn Rivers as his last observation of prairie dogs.

Allen (1874) travelled the prairie grasslands between the Missouri, Musselshell and Yellowstone Rivers and reported that the mountain plover was met at widely distant intervals. It was seen more frequently on the plains bordering the Yellowstone and Musselshell Rivers than elsewhere. Two or three small flocks were seen in September but generally they were seen only in single pairs at intervals of several days. One of these migrating flocks was observed along the lower Yellowstone River in the vicinity of Glendive.

Grinnell (1876) reported this species not at all abundant in the portion of Montana through which he traveled (Fort Carroll - Yellowstone National Park). He collected two females and two downy young on the first of August near Haymakers Creek (Twodot area). (Our observations show that plovers are already migrating out of this area by late July.) These were the only mountain plovers which he observed. McChesney (1879) regarded the mountain plover as abundant in the spring around Fort Custer (Hardin, Montana) and Thorne (1895) considered the mountain plover to be rare around Fort Keogh (Miles City).

Coues (1874a&b, 1878) noted mountain plovers during his survey of the Montana-Canadian border during the summer of 1874. He first encountered mountain plovers at the mouth of the Milk River and observed them all the way to the Sweet Grass Hills at which point they were no longer seen (he entered this area in late summer when plovers are harder to find). Within this area, Coues considered them as a common species and stated that they bred in considerable numbers (Coues 1878). Coues (1874) stated that "the bird nests anywhere on the dry prairie; but if it has any preference, it is for the stretches of low loose grassy ground where the prairie dogs settle, as distinguished from the more arid and gravelly or stony prairie". Specific collection sites include the area around Frenchman River which had the greatest number of plovers, the two forks of the Milk River, and the crossing of the Milk River out of Canada.

Settlement Period Records (1900-1929)

Silloway (1903) compiled a list of birds in Fergus County (in 1903 this also included all or parts of Judith Basin, Wheatland, Golden Valley, and Musselshell Counties) and considered the mountain plover as a regular summer resident from May through September (Table 1). Watts and Eichhorn (1981) noted that four species of birds (mountain plover, burrowing owl (*Athene cunicularia*), long-billed curlew (*Numenius americanus*), grasshopper sparrow (*Ammodramus savannarum*)) associated with the shortgrass prairie are much reduced in abundance from Silloway's description. They considered the mountain plover as uncommon within the same area.

In the Terry area, Cameron (1907) reported the mountain plover as rare in Custer and Dawson Counties with two or three pairs breeding annually on the prairie dog colonies in the vicinity of Terry. Cameron reported observing eggs on 23 May and hatched young on 15 June 1898. Mountain plovers were also noted in the Great Falls and Sun River area by Cooke (1910), near Big Sandy (Bent 1929), and the Three Forks area by Saunders (1911). Saunders (1911) noted that only a small portion of the valley near Three Forks was under cultivation at the time and the majority of the area was rolling grassland. Saunders considered the mountain plover as a common grassland species in this area. He also noted that the mountain plover was not found in the Gallatin Valley and attributed extensive cultivation as a possible explanation for its absence in this area. Four Montana

mountain plover specimens are at the University of Michigan vertebrate museum. These specimens (3 males and 1 female - UM #s 51,386-51,389) were collected in from 4-14 May 1917 in Garfield County near Jordan, Montana.

Table 1. List of naturalists reporting observations of mountain plovers during the 1800s and early 1900s.

Naturalist	Area	Comments
Hayden, reported by Coues 1874	near Big Timber near Great Falls	collected specimens
Cooper 1869a&b	Fort Benton & Great Falls area	plovers on prairie dog colonies otherwise rare
Coues 1874 & 1878	between the Milk R. and Canadian border	common, usually found on prairie dog colonies, collected specimens
Allen 1874	between the Yellowstone and Musselshell Rivers	infrequent, observed every few days
Grinnell 1876	Two Dot/Haymakers Creek	collected specimen not abundant
McChesney 1879	Fort Custer near Hardin	abundant in spring
Thorne 1895	Fort Keogh	rare
Silloway 1903	Fergus County	regular summer resident
Cameron 1907	Terry	few breed on prairie dog colonies
Cooke 1910	Sun River & Great Falls	
Saunders 1911	Three Forks	common in area
U. of Michigan 1917	Jordan	5 specimens
Bent 1929	Big Sandy	migration dates

Recent Records (1930-1990)

The major mountain plover population (use of the word population in this paper does not imply genetically distinct

groups but instead refers to mountain plovers living within an identifiable geographic region) in Montana is associated with prairie dog colonies in Phillips and Blaine Counties. These mountain plovers have been extensively studied (Knowles et al. 1982, Knowles and Knowles 1984, Olson 1984, Olson 1985, Olson and Edge 1985, Olson-Edge and Edge 1987, Prellwitz 1993, Knopf 1991, Densmore pers. commun.). One mountain plover was collected by Dr. Robert Eng in southern Phillips County in 1969. Knowles and Knowles (1984) plotted the known distribution of plovers in this area during the early 1980s and reported that mountain plover use of prairie dog colonies varied from 18% on BLM and private lands in Phillips County, to 26% on the Fort Belknap Indian Reservation and 53% on the Charles M. Russell National Wildlife Refuge within Phillips County. Prairie dog colonies used by mountain plovers on the Fort Belknap Indian Reservation averaged 176 ha while on the CMR colonies used by plovers averaged 56 ha (Olson-Edge and Edge 1987). Prairie dog colonies used by mountain plovers were the larger colonies and on Fort Belknap Reservation, they occupied 69% of the prairie dog acreage. Although this population cannot be traced directly to any presettlement or settlement period accounts, Coues' (1878) sightings of mountain plovers north of the Milk River were probably continuous with this population.

Mountain plovers have been observed directly south of the Phillips County population in northern Fergus and Petroleum Counties. During a 14 year period from 1977-1990, a total of 7 sightings of 10 mountain plovers were recorded on prairie dog colonies along the Musselshell Trail (Doug Ayers, BLM biologist pers. commun. and BLM files, Lewistown).

Mountain plovers were recorded from 1978 through 1989 southwest of Glasgow along Little Beaver Creek (Green 1982, 1983, Green and Engle 1984, Prellwitz 1993, Vern Stofleth, BLM biologist, pers. commun.). A total of 123 observations of 314 mountain plovers has been recorded in this area during this period. These plovers are not associated with prairie dogs, but instead are found over a 165 mi^2 area in areas with dwarf shrub plant communities. On suitable habitat, density of mountain plovers reported by Green (1982, 1983) and Green and Engle (1984) declined from 16.4 plovers/mi^2 in 1981 to 4.5 plovers/mi^2 in 1984. This population is very close to where Coues first encountered plovers near the mouth of the Milk River and is probably a remnant of the plover population described by him.

Soper (1941) recorded 4 mountain plovers near Wildhorse, Alberta in June 1941. Wallis and Wershler (1981) reported finding mountain plovers at a few specific sites between Onefour and Wildhorse Alberta just north of Montana. They reported that plovers were associated with alkali areas, heavily grazed winter pastures, and burned sites. Observations of mountain plovers at these sites has not been consistent over the years (Steve Brechtel, pers. commun.). Surveys between the Sweet Grass Hills and the Milk River in Alberta have not produced any plover observations (Steve Brechtel, pers. commun.). Peart and Woods

(1980) recorded observations of 10 mountain plovers near Val Marie, Saskatchewan.

Haymakers Creek on the south side of the Little Belt Mountains was identified by Pettingill (1981 (first edition appeared in 1951)) as the location in Montana to find mountain plovers. He described mountain plovers to be present on and along either side of the gravel road (Olaf Rd.) north of Twodot for a distance of 12 km. Haymakers Creek was the location of the 1876 report of mountain plovers by Grinnell. This population continues eastward along the southern side of the Big and Little Snowy Mountains. Dr. Robert Eng collected a mountain plover on 22 April 1972 about 8 miles north of Harlowton (the site is now a wheat field). Others reported seeing mountain plovers in this area during the 1980s (Bill Haglan, pers. commun. USFWS biologist, David Genter pers. comm., Montana Natural Heritage Program, Knowles 1985).

In southeastern Montana, a few mountain plovers were observed in Dawson, Garfield, Prairie, Custer, and Carter Counties during the 1970s and 1980s (Neil Martin, pers. commun., Montana Dept. Fish, Wildlife, and Parks, Miles City). One mountain plover observed in Prairie County was accompanied by a chick and apparently is the basis for the breeding record listed by Skaar et al. (1985) for latilong 33. Unfortunately, the number of plovers, observation dates, and specific locations of these sightings are not available. In addition to these observations, Dood (1980) recorded the observation of a single mountain plover on 15 August 1979 on a prairie dog colony along Custer Creek 25 miles west of Terry. Some of these observations correspond to sightings made by Cameron (1907) during the settlement period.

Several mountain plovers have been recorded over a 20 year period in southwestern Montana. One plover was observed in June 1970 on a grassy ridge extending southeast from the Elkhorn Mountains about 11 km south of Radersburg. This bird was observed during a breeding bird survey between Boulder and Toston (Pat McKinney pers. commun.). In the same year, Dr. P.D. Skaar visited this site and observed at least one more mountain plover (Pat McKinney, pers. commun.). This route was censused annually for 10 years and this was the only observation of a mountain plover. Apparently this observation is the basis for listing the mountain plover as breeding in latilong 28. Mountain plovers were also reported about 5 km north of Whitehall in the Whitetail Valley just east of the old Whitehall cemetery (David Ewer, pers. commun. Last Chance Audubon Chapter). Ewer first observed a plover here in 1978 and he consistently observed plovers at this site from 1987 to 1990 when two juvenile birds were seen. He estimated that two pairs of plovers used a grassy ridge extending southwest from the Bull Mountains. Mountain plovers in southwestern Montana probably correspond to those reported on by Saunders (1911).

Current Montana Mountain Plover Distribution

Surveys for mountain plovers during the 1990s show that mountain plovers occur at a minimum of nine locations in Montana (Figure 5, Table 2). Reproduction has been documented at all sites except two. Montana's largest and most extensive breeding population (or subpopulation) is associated with prairie dog colonies in Blaine, Phillips, and northern Fergus and Petroleum Counties. This population has been extensively studied and also attracts the attention of casual observers.

Based on systematic surveys and incidental observations (Prellwitz 1993, Rogers 1997, Jody Peters BLM biologist and Jerry Kaiser BIA biologist, pers. commun, BLM files, Lewistown) in this area, mountain plovers occur immediately north of the Milk River in prairie dog colonies near Harlem and Malta, southward through Phillips and Blaine Counties on prairie dog colonies either side of the Little Rocky Mountains, and south of the Missouri River on a few prairie dog colonies in northern Fergus and Petroleum Counties.

The Central, Northeastern, and Southwestern study areas represent the second, third, and fourth largest mountain plover populations, respectively, in Montana. The documented area used by plovers was 648 km^2 2,565 km^2 and 3,620 km^2 for the Northeastern, Central and Southwestern study areas, respectively. However, mountain plovers in the Southwestern study area were restricted to several very isolated sites while plovers in the other two study areas were more evenly distributed across the landscape. One mountain plover was recorded by John Shackford (1997) in a fallow wheat field near Moccasin, Montana (north side of the Little Belt Mountains) in July 1995. Presumably, this bird was part of the Central Montana population. Plovers in the Northeastern, Central, and Southwestern Montana study areas appear to be documented during the presettlement and settlement periods by Coues (1978), Grinnell (1876) and Saunders (1911), respectively.

Very few mountain plovers have been observed at the other five sites with known current use. In Teton County, mountain plovers are known to use only a single grassland ridge about 15 km west of Fairfield. This ridge is approximately 3 km wide by 8 km long that is intensively grazed by sheep. Up to three nesting pairs of plovers have been observed on this ridge (Phil Harris, sheep rancher, pers. commun.). A careful examination of this ridge in July 1996 did not produce any plover observations which was the first year in many years that plovers were not observed here (Phil Harris, sheep rancher, pers. commun.). A second ridge in this area was formerly used by plovers until land ownership changed and the site was graze by cattle rather than sheep (Phil Harris, pers. commun.). Similar isolated habitat (isolated by agriculture) in the vicinity of this occupied site was examined in May 1994 and July 1996 but no plovers were observed. The plovers in this area are apparently a remnant population of that reported along the Sun River by Cooke (1910)

The Toole County site used by mountain plovers is based on

two observations in 1996 of a pair of mountain plovers with a single brood of three chicks. The habitat used by these birds is restricted to an intensively grazed (cattle) grassland site occupied by Richardson's ground squirrels. Approximately 25 km^2 of similar habitat occurs in this general area, and isolated (isolated by agriculture) parcels of this habitat were found about 16 km north of this site immediately south of the Sweetgrass Hills. Observations in Toole County during 1997 did not result in additional plover observations (Harriet Marble, pers. commun.). Although Coues (1878) failed to find mountain plovers near the Sweet Grass Hills, this could have been due to the fact that he traveled through this area in the late summer and early fall after plovers had migrated.

Up to six different adult mountain plovers have been observed in northern Treasure County about 10 km directly south of Ingomar. These plovers have been found at silty overflow sites dominated by dwarf shrub plant communities along a 2 km length of Froze-to-Death Creek. Plovers have been observed there from 1994 through 1996 but none were found in this area in 1997. This general area was surveyed by Allen during 1874 and was reported to contain some mountain plovers.

Mountain plovers have been found from 1994 through 1997 at a single site in Lone Tree Creek in Carter County in extreme southeastern Montana about 30 km southwest of Ekalaka. No more than 2 plovers have been observed at a time in this area. This area is characterized by dwarf shrub communities occurring in silty overflow sites and areas of bentonitic soils interspersed with shrub/grassland habitat. This combination of habitats is restricted to 20 km^2 area, but similar habitat is found in other drainages in the general area. These other areas were searched in 1995, 1996, and 1997 but did not produce any additional plover observations. There are no presettlement or settlement period records of mountain plovers in this area. These sites are close to suitable plover habitat found in Bowman County, North Dakota and Butte County, South Dakota but the mountain plover is considered the as extirpated in these 2 states (Fannes and Stewart 1982, Houtcooper et al. 1985, Leachman and Osmundson 1990).

Mountain plovers were found in an area on the west and south sides of the Pryor Mountains during 1996 and 1997. Yellowstone Valley Audubon Chapter members reported seeing plovers in the vicinity of Gyp Spring (16 km east of Warren) in May 1996 and May 1997 (Bill Roney). Another pair of plovers were observed in the Gyp Spring area on 17 May 1997 by Terry McEneaney (wildlife biologist, YNP, pers. commun.). Plovers observed in this area were using dwarf shrub communities dominated by birdfoot sage. Nuttall's saltbrush is also present in this area. We observed a mountain plover on 23 June 1997 on the west side of the Pryor mountains on a large flat dominated by blue grama. There are no presettlement or settlement period records for mountain plovers in this area. However, Knight (1902) showed mountain plovers breeding south of this area in Wyoming and recent records show

mountain plovers still breeding here (Wyoming Game & Fish 1989).

Table 2. List of general areas in Montana where mountain plovers were recorded during the 1990s.

Location	Habitat Association	Minimum Number
Phillips, Blaine, N. Fergus, & N. Petroleum Counties	Grasslands: Prairie dog colonies & some use of barren areas with glacial till	in 18-53% of the prairie dog colonies 69% of acreage occupied
Wheatland, Golden Valley Musselshell Counties	Grasslands: Stockwater sites grazed by sheep and cattle & prairie dog colonies	118 adults counted in 1992
Valley County	Dwarf shrub communities associated with silty overflow sites & bentonitic soils	39 adults counted in 1996
Jefferson, Madison, Broadwater Counties	Grasslands: Prairie dog colonies & Stockwater sites grazed by cattle	35 adults counted in 1992
Treasure County	Dwarf shrub communities associated with silty overflow sites	6 adults counted in 1995
Carter County	Dwarf shrub communities associated with silty overflow sites & bentonitic soils	2 adults counted in 1995
Carbon County	Dwarf shrub communities & blue grama flats	3 adults counted in 1997
Teton County	Grasslands: Ridge grazed by sheep	6 adult birds reported by a rancher
Toole County	Grasslands: Grazed by cattle & ground squirrels	2 adults counted in 1996

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Changes In Distribution

There are no current records for mountain plovers along the Yellowstone and upper Missouri River, an area that they were documented to occur in during the presettlement period. These areas formerly contained abundant prairie dog colonies (Cooper 1869a&b, Stuart 1902) but they have been largely eradicated and the area is intensively farmed.

There are a few recent and only one current record of mountain plovers between the Yellowstone and Musselshell. The plains between the Yellowstone and Musselshell Rivers were surveyed by Allen (1874) and mountain plover were noted at infrequent intervals.

Mountain plovers remain in the area south of the Little Belt and Snowy Mountains where Grinnell (1876) collected mountain plovers in the 1870s. However, the slow conversion of this area to agricultural crops appears have caused a decline in numbers based on a description by Pettingill (1981) and a 1972 collection site.

Mountain plovers and prairie dogs were considered common north of the Milk River in Montana during an 1874 survey (Coues 1878). The only recent and current documentation of plovers in this area are plovers observed in a few prairie dog colonies near Harlem and Malta. Prairie dogs were largely extirpated from this area through eradication efforts earlier in the century.

There are no current records of mountain plovers near Big Sandy (Bent 1929) Fort Benton (Cooper 1869a&b), and Great Falls (Cooke 1910). A few plovers remain on 1 ridge along the Sun River (Cooke 1910). A remnant population of mountain plovers persists in southwestern Montana but there are no current records in the Three Forks area where they were formerly considered common (Saunders 1911).

Areas Surveyed Without Plover Observations

In addition to the areas with documented mountain plover populations, we have surveyed many other areas of Montana east of the Continental Divide since 1991 during late spring and early summer (Table 3). These survey areas were selected because they contained potential mountain plover habitat with specific sites that appeared suitable for plover use, or we found presettlement or settlement period records for these areas. Many of these survey areas were searched during more than one year and they produced negative results. Although we did not find plovers at any of these sites, negative results are not conclusive evidence that mountain plovers are not in these areas; low density plovers populations are not easily detected and may be over looked with a single pass through an area. However, our surveys were of suitable intensity to conclude that the areas do not support large plover populations.

Table 3. List of areas surveyed for mountain plovers during the 1990s with negative survey results.

Benches south of the Highland Mountains
Benches north of the Ruby Mountains
Upper Beaverhead River Valley south of Clark Canyon Dam
Plains either side of the lower Madison River
Upper Yellowstone River (Paradise Valley)
Yellowstone River Valley Columbus to Livingston
Benches associated with the Beartooth Mountains from Bridger Creek to Redlodge Creek
South of Hardin in the vicinity of old Fort Custer
Prairie dog colonies north and south of the Yellowstone River near Terry (Custer Creek and the lower Powder River)
Prairie dog colonies on the Northern Cheyenne Indian Reservation
Thompson Creek west of Alzada, Willow Creek northwest of Alzada and Cottonwood Creek north of Alzada
Little Missouri River bottomlands in Bowman County, ND and the Little Beaver Creek area southeast of Baker
Big Porcupine Creek north of Vananda
Prairie dog colonies northwest of Glasgow
Prairie dog colonies southwest of the Northeastern Montana study area
The area north of Chinook
Either side of the Milk River northwest of Havre
South side of Sweetgrass Hills west to the Kevin Rim
Rocky Mountain front from Augusta to Dupuyer
Ulm Pishkun west to the Rocky Mountain Front
North of the Belt Mountains from Raynesford to Judith Gap
Prairie dog colonies south of Big Sandy
East side of the Elkhorn Mountains from Radersburg to Winston
West side of the Bull Mountains from Cardwell to Boulder

Mountain Plover Numbers

A total of 480 observations of 1,138 mountain plovers (2.37 birds/observation) was recorded during all years for all survey areas (Table 4). Adults accounted for 845 of these birds and 270 birds were classified as chicks or immatures (23 birds were not seen well enough to distinguish between adult or immature). Over 90% of these observations were made within the 3 major study areas. The Central study area accounted for approximately half of the mountain plover observations and about 60% of the birds observed. Average group size for the Northeastern, Central, and Southwestern study areas was 1.70, 2.93, and 2.29 mountain plovers per observation, respectively.

Although our study was not designed to provide a population estimate for each major study area (Northeastern, Central, and Southwestern), we feel that our survey efforts have been thorough enough so that the maximum number of adult plovers observed in each study area is a comparative index of number of birds in each

area. In each of these study areas, we have conducted systematic surveys to delineate the mountain plover distributional range, and our surveys sample most the area within the known occupied range.

In the Northeastern study area, our highest non-repeated count was obtained in 1996 and we could be certain of 43 different adult birds. For the Central study area, our highest non-repeated count came in 1992 and we could be certain of 118 birds, and in the Southwestern study area, we could be certain of at least 35 different adult birds in this area during 1992. These figures represent the minimum number of birds occurring in each study area and are not population estimates.

Table 4. Number of mountain plovers observed in Montana from 1991-97 by study area and study areas combined. Total birds observed includes birds not classified to age.

Study Area	Total Obs.	Total Birds	Adult Birds	Juvenile Birds
Northeastern	141	240	181	55
Central	230	675	463	193
Southwestern	70	160	144	16
Blaine Co.	18	27	26	1
Phillips Co.	5	6	2	4
Treasure Co.	9	18	17	1
Toole Co.	1	3	1	2
Big Horn Co.	1	1	1	0
Carter Co.	3	4	4	0
Combined	480	1138	845	270

Relative Trend in Numbers

Relative numbers of adult mountain plovers recorded at census stations at the Northeastern study area showed no consistent trend from 1992 to 1997. During this period, 17 to 35 adult mountain plovers were recorded along the permanent survey route at 11 to 21 stations (Table 5). The count during 1995 was incomplete due to rain. Five stations were not visited and 2 of these stations usually produced plover observations. The highest count came in 1996 when 35 plovers were observed at 21 stations (Table 5). The census route was run twice in 1992 to help establish a suitable survey period. The second survey in late July 1992 resulted in fewer birds being observed and appeared too

late in the year to obtain good results. During 5 survey years at this study area, mountain plovers were observed at 56% (39) of the stations.

Table 5. Summary of adult mountain plovers observed at 70 station sites along a mountain plover survey transect in the Northeastern Montana study area.

YEAR	DATE	# ADULT PLOVERS	# Stations
1992	5-8 June	17	12
1992	19-22 July	9	4
1994	22-24 June	20	13
1995	25-27 June	19	11*
1996	29 June - 1 July	35	21
1997	6-8 July	27	13

* 5 stations not visited due to rain

A similar lack of a consistent trend was obtained along the census route at the Central study area (Table 6). We observed 103 adult plovers at 34 observation stations while setting up the permanent census route in June 1992. A second survey of the route approximately one month later in mid-July 1992, resulted in observations of only 52 adult plovers at 21 stations. This decline in plovers was similar to the seasonal change observed in the Northeastern study area. The next complete survey of the route came in June 1994 when we observed only 19 adult birds at 11 stations. Persistent windy weather during the June 1994 survey of the Central study area route may have influenced the survey results. The Central study area route was surveyed again in July 1994 and we recorded 53 adult plovers at 14 stations. Numbers of birds observed during the 1995 survey declined slightly and appeared to be related to the agricultural conversion of 3 observation stations normally used by plovers. However, the second highest count for this route came in July 1996 when 79 adult birds were seen at 22 stations. The count was much lower in 1997 but two of the three survey days had frequent showers and thunderstorms which may have influenced mountain plover observability. During the 5 survey years, mountain plovers were observed at 69% (62) of the stations.

Table 6. Summary of adult mountain plovers observed at 90 station sites along a mountain plover survey transect in the Central Montana study area.

YEAR	DATE	# ADULT PLOVERS	# Stations
1992	22-25 June	103	34
1992	14-18 July	52	21
1994	11-14 June	19	11
1994	7-9 July	53	14
1995	18-20 July	39	11
1996	11-13 July	79	22
1997	8-10 July	40	10

Changes in relative numbers of mountain plovers at specific sites in the Southwestern study area could be interpreted as decline in plovers across this region (Table 7). While numbers of mountain plovers counted at sites occupied by prairie dogs remained relatively constant from 1992 through 1997, mountain plovers observed at grassland sites grazed by cattle appeared to be in decline. For example, the vicinity of the old Whitehall Cemetery was previously identified as a site used by mountain plovers (David Ewers, Last Chance Audubon Chapter, pers. commun.). Although this site appears to be intensively grazed each year during winter and spring, we have yet to observe a mountain plover in this area since 1991 despite intensive surveys. We have not been able to find mountain plovers on the Fish Creek Bench since 1994, and 1992 was the only year we found plovers on the Elkhorn Bench (plovers were observed here in the early 1970s). Grazing intensity at these two sites as well as the Goodrich Gulch alluvial fan varies greatly between years and may influence mountain plover use of these sites.

The monitoring of mountain plover numbers at specific sites along permanent census routes has shown that mountain plover numbers can vary substantially within and between years. These variations may or may not be reflective of actual changes in mountain plover numbers. Survey results may be influenced by weather conditions, time of the year, annual grass growth, and random effects. Surveys in the Central study area have shown that strong wind (>30 km/h) and precipitation can reduce plover counts. During windy weather, some birds have been observed to crouch on the leeward side of small shrubs or bunches of grass. However, we have observed plovers to remain active in moderate snow and rain showers. Mountain plover observability may also be influenced by the time of the year surveys are conducted. Birds incubating eggs are probably less observable than birds with

broods or birds engaged with courtship displays. Mountain plovers do show some periodicity in their daily activity patterns and the time of day that surveys are conducted may also influence survey results (see Fig. 8). The 1992 survey results suggested that mountain plover surveys should be conducted prior to mid-July. We have observed fledged young and adults to leave the Central study area as early as 14 July. We have also found that in years of abundant precipitation, needle-and-thread grass produces profuse, tall seed heads that reduce the effective scanning area. In addition, the effective scanning radius in areas intensively grazed by livestock is greater than areas only moderately grazed.

Monitoring of census stations from 1992 through 1997 showed mountain plovers were both consistent in their use of some areas and opportunistic in their use of other areas. When established, the census stations at the Northeastern and Central study areas included many potential sites with no known use by plovers. Some of these potential sites were used by mountain plovers in subsequent years and some were never used during the entire survey period. Some stations produced mountain plover observations each survey year, and a few stations produced mountain plover observations only in 1992 but not in subsequent years. Yearly variation in mountain plover distribution at both the Northeastern and Central study areas appeared to be related in part to a changing distribution of livestock grazing.

Mountain Plover Reproduction

Reproduction was documented at the 3 major study areas and at 4 of the 6 other areas with known populations. Circumstantial evidences suggests that mountain plovers are probably also breeding at the Carter and Carbon Counties sites that currently lack hard data for breeding. Mountain plovers have been observed in most years in Lone Tree Creek (Carter County) since 1994 during the period they normally would breed. Similar observations have been made adjacent to the Pryor Mountains (Carbon County) during 1996 and 1997. Although no young were seen, the behavior of a single adult plover on the west side of the Pryor Mountains was typical of an adult with a newly hatched brood.

The first mountain plover brood was observed on 8 June and the last observation of an incubating adult was on 18 July. Observations of incubating adults in mid-July would suggest that at least some plovers renest if nest is destroyed. This nesting chronology is about one month later than described for Colorado by Graul (1975). We examined 5 nests with incubating adults during the surveys and each contained 3 eggs which is consistent with other recent observations of plover nests in Montana (Sally Olson-Edge, and Steve Densmore pers. commun.) and reported in the literature (Graul 1975). The available data suggests that mountain plover egg production in Montana is within the normal range. Iko et al. (1997) found no significant contaminants or

trace minerals in mountain plover and Knopf (1992) reported no significant contaminants in eggs collected in Colorado and Montana.

Table 7. Maximum number of adult mountain plovers observed at specific locations at the Southwestern Montana study area.

Census Area	1992	1993	1994	1995	1996	1997
Willow Springs Prairie Dog Colony	10	9	4	8	8	6
Elkhorn Bench	2	0	0	0	0	0
Upper Whitetail Valley Prairie Dog Colony	2	8	6	4	3	4
Lower Whitetail Valley Prairie Dog Colony	3	No Sur.	2	No Sur.	2	No Sur.
Whitehall Cemetery	0	0	0	0	0	0
Fish Creek Bench	9	2	0	0	0	0
Goodrich Gulch Alluvial Fan	7	No Sur.	3	3	0	0

A total of 147 broods (270 chicks) was observed in all areas during all years with an average brood size of 1.84 (Table 8). These data compare favorably with data collected by others in Montana. Knowles et al. (1982) collected data on mountain plover use on prairie dog colonies on the Charles M. Russell National Wildlife Refuge from 1978 to 1980 and 19 broods were recorded with an average of 1.74 chicks per brood. We also reviewed data collected by Green (1982, 1983), Green and Engle (1984), Prellwitz 1993, and BLM files from 1978 to 1987 in the Northeastern study area and observations of 80 broods resulted in an average brood size of 1.61. The available data would suggest that average mountain plover brood size in Montana has changed little during a 20 year period.

A total of 69 downy broods was observed with the average

brood size of 2.04. Fifty-three broods were classified as feathered and averaged 1.73 chicks per brood. For immature birds, 25 broods were observed and they averaged 1.48 chicks per brood. Only 19% of the downy broods contained 3 chicks and by the time chicks had developed feathers only 11% of the broods contained 3 chicks. Over half of the broods with downy chicks contained 2 chicks while only about a third of the broods with feathered chicks contained 2 birds. Single chick broods were the most frequently observed for chicks classified as feathered (49%) and immatures (71%). These data indicate that as a minimum approximately 30% of the chicks are lost shortly after hatching (or not all eggs hatch), and that another 25% of the chicks are lost prior to fledging. This analysis does not account for nest destroyed prior to hatching or broods where all the chicks are lost. Others have reported a similar loss of chicks after hatching. Graul (1975) reported most chick mortality occurred within 3 days after hatching. McCaffery et al. (1984) reported an average brood size for 1-5 day-old chicks (downy chicks) of 2.1 and noted that the average brood size declined with an increase in age.

It appears to be common for mountain plovers to lose at least one chick shortly after hatching. An example of this was observed in July 1992 at the Central study area. A newly hatched brood of 3 chicks accompanied by an adult plover was observed on 15 July, and early the next morning at the same site, only one chick was with the adult. As a matter of chance, a second chick was located about 150 yards from the adult as a result of hearing repeated distress calls from the chick. This situation was watched for about 0.5 hours and it was apparent that the chick was not capable of finding the adult and that the adult was not looking for the chick. The third chick was not observed during this period. The cause of the apparent loss of one chick and the abandonment of a second chick was not determined, but predation is a likely explanation.

Most of the mountain plover brood data was collected from the Northeastern and Central study areas where the average brood size was 1.96 and 1.82, respectively. Average brood size is a measure of chick survival and it appears to be within the normal range for these two areas. Number of chicks per adult plovers observed during July of each survey year was 0.37 and 0.51, for the Northeastern and Central study areas respectively. A flash flood occurred on 6 July 1997 at the Northeastern study area and most of the low lying areas used by plovers had 5-15 cm of water flowing over the ground. No chicks were observed during the 1997 survey period and if the 1997 data is dropped from the analysis the number of chicks to adult birds would be 0.44. (The Northeastern study area was subjected to flash floods in June 1991 and no plovers observed in this study area when first examined during July 1991.)

The number of chicks to adult plovers is both a measure the number of broods produced and chick survival, while the average brood size is a measure of chick survival. Since no consistent

trend in mountain plover numbers was noted at the permanent census stations established at the Northeastern and Central study areas, it is concluded that an average brood size of 1.82-1.96 and a ratio of chicks to adults of 0.37-0.51, is probably adequate to maintain mountain plover populations at these sites.

The average brood size in the Southwestern study area was only 1.33 and the number of chicks observed per adult during July was 0.18. Both figures are considerably lower than for the other two study areas. Our monitoring of permanent census stations in the Southwestern study area indicate that there may be a downward trend in plovers using this area. It is concluded that an observed average brood size of 1.33 chicks and a ratio of 0.18 chicks to adult is probably not adequate to maintain a population.

Observations of mountain plovers during the month of July is the period with the greatest probability of finding chicks with adults. Data gathered during July from 1991 to 1997 resulted a ratio of 0.44 chicks (all age classes) to 1 adult.

Table 8. Frequency of mountain plover broods based on number of chicks in a brood for the Northeastern (NE), Central (CENT.), and Southwestern (SW.) study areas and all observations in all areas combined (COMB.) for 1991 through 1997.

Study Area	Downy Chicks Brood Size					Feathered Chks. Brood Size				Immatures Brood Size			
	1	2	3	4	5	1	2	3	4	1	2	3	4
NE.	4	6	6	0	0	1	1	1	0	5	1	1	1
CENT.	12	24	8	1	2	22	15	5	3	10	3	3	0
SW.	1	3	0	0	0	2	2	0	0	1	1	0	0
COMB.	18	35	13	1	2	26	18	6	3	17	5	2	1

Adult plovers will forage together and there is mixing of broods as indicated by broods with more than 3 chicks (seven observations) or with broods of obviously different ages (4 cases of downy chicks and feathered chicks together, 1 case of downy chicks with immatures together, and 4 cases of feathered chicks with immatures together). Overall, about 13% of the brood observations represented situations where more than one brood was present.

Although we did not observe any cases of predation on adult or juvenile mountain plovers, predation must have been a significant factor affecting juvenile survival. We did notice that mountain plovers in close proximity to long-billed curlews at the Central study area, appeared to respond to curlew alarm calls when avian predators were present (primarily northern

harriers (*Circus cyaneus*)). Common ravens (*Corvus corax*) were attracted to the Goodrich Gulch alluvial fan by the Twin Bridges landfill, and they were observed to frequent stock water sites use by mountain plovers. Coyotes (*Canis latrans*) and red foxes (*Vulpes vulpes*) were two mammalian predators observed in areas used by mountain plovers. Since there is strong evidence that chicks are lost throughout their growth period, it is difficult to compare productivity rates among study areas or among years because data were not collected simultaneously at all study areas within a year or at the exact same time period among years.

Habitat Use

Habitat use by mountain plovers was consistent among years within a study area but varied among study areas depending on habitat availability (Table 9). Within each study area, one or two habitats were clearly sought out and selectively used. In the Northeastern study area, mountain plovers selected the Nuttall's saltbrush and yellow eriogonum habitats. These two types accounted for 90% of the observations which is far greater than their availability (not determined but estimated to cover 25-33% of the landscape). Soils with bentonite in them were common in the Northeastern study area but were only occasionally used by plovers possibly because these sites contained irregular topography.

In the Central study area, the STCO/BOGR habitat was the most widely available and most frequently used habitat. Within this habitat, mountain plovers clearly selected areas of intensive livestock grazing (discussed later in this report). Vegetation at ungrazed sites was generally too high for mountain plovers to use. Agricultural areas accounted for approximately 34% of the landscape and were the second major habitat in this study area. However, only 1% of the plover observations occurred on this type. Further evidence of the avoidance of agricultural land by plovers came when 3 grassland sites used by plovers were converted to wheat production in late 1994. Mountain plovers have not been observed at these sites since that year. Recorded use of agricultural sites has been limited to fallow wheat fields located adjacent to grassland sites. In each case, birds were observed to fly between grasslands and agricultural lands.

In the Southwestern study area, all observations of mountain plovers were in the STCO/BOGR habitat. This was the dominant habitat in topographic situations suitable for mountain plovers. Within this habitat, mountain plovers were selecting for prairie dog colonies and intensively grazed sites. Approximately a quarter of the Southwestern study area has been converted to agricultural production and no mountain plovers have been observed in a agricultural fields.

Eight percent of our observations (18) in the Central study area have included birds on gravel roads. Over half (11) of these observations were adult birds with broods and most of these groups contained downy chicks traveling on the road bed. Vehicle impacts may be a significant mortality factor for young broods

traveling on gravel roads. The average number of chicks observed in these 11 broods traveling on gravel roads was 1.36. We also have observations of adult mountain plovers on gravel roads feeding on grasshoppers killed by vehicles.

Most mountain plover observations at all three study areas were at sites with estimated vegetative height less than 10 cm (Table 10). Availability of these sites in the Central and Southwestern study areas was extremely limited, while in the Northeastern study area short vegetation was more common. However, mountain plovers in the Northeastern study area were observed with a higher frequency in vegetation over 10 cm in height than the other two study areas. Generally, these sites with taller vegetation had widely spaced big sagebrush, or bunches of Nuttall's alkali-grass with considerable bare ground. In such situations, plovers seemed tolerant of the taller vegetation when bare ground was abundant.

Table 9. Habitats used by mountain plovers at the Northeastern (N=141), Central (N=230), and Southwestern (N=70) Montana study areas from 1991-97. Figures are percent of observations.

Habitat	Northeastern	Central	Southwestern
STCO/BOGR	0	96	100
AGSP/BOGR	0	1	0
AGSM	4	2	0
BOGR	<1	0	0
ATGA	56	0	0
ERFL	31	0	0
Bentonite	8	0	0
Agricultural	0	1	0

We measured vegetative characteristics at sites used by mountain plovers during 1994-1996 and the results are very similar to information recorded during general observations (Table 11). The average vegetative height at sites used by mountain plovers was under 6 cm and over 50% of the ground surface was bare soil and lichens. Sites used by plovers with the shortest vegetation, least amount of vegetative cover, and greatest amount of bare ground were found at the Northeastern study area. The Central study area had the highest amount of grass cover at sites used by plovers. The abundance of sub-shrub cover in the Southwestern study area was due to fringed sagewort in prairie dog colonies where 5 of the 6 transect were located.

Use of topography at the three study areas has been

consistent within a study area among years but varies greatly among study areas. These differences are related to the physiography of each study area. At the Central and Southwestern study areas, mountain plovers were primarily found on ridge tops or alluvial fans extending from the mountains (Table 12). At the Central study area, mountain plovers were also observed in the valley bottoms of the larger drainages where they had been heavily grazed by cattle and sheep during winter and spring. Nearly all observations of mountain plovers in these 2 study areas were on slopes of 0-5% (Table 13). Examination of topographic maps showed that the overall slope of sites used by mountain plovers was generally less than 2%. In the Central study area, we found plovers on ridges ranging in elevation from 1,124 m to 1,708 m. The elevational range of mountain plover observations at the Southwestern study area was 1,403-1,525 m.

Table 10. Estimated average vegetative height at sites used by mountain plovers at the Northeastern (N=141), Central (N=230), and Southwestern (N=70) Montana study areas from 1991-97. Figures are percent of observations.

Vegetative Height	Northeastern	Central	Southwestern
< 5 cm	12	27	14
5-10 cm	71	63	80
11-15 cm	16	10	6
16-20 cm	1	0	0

Table 11. Vegetative characteristics of sites used by mountain plovers for the Northeastern (NE)(N=17), Central (CENT) (N=12), and Southwestern (SW) (N=8) Montana study areas from 1994-1996. Heights are in centimeters.

Study Area	Ave. Max. Veg. Height	Ave. Veg. Height	Ave. % Grass Cover	Ave. % Forb Cover	Ave. % Sub-Shrub Cover	Ave. % Lichen Cover	Ave. % Bare-ground
NE	8.5	3.8	4.8	4.0	12.6	4.4	85.0
CENT	14.6	5.3	48.6	4.5	13.6	14.8	36.0
SW	12.7	5.4	25.2	3.7	20.8	3.5	49.9

Table 12. Topographic situations used by mountain plovers at the Northeastern (N=141), Central (N=230), and Southwestern (N=65) Montana study areas from 1991-97. Figures are percent of observations.

Topographic Situation	Northeastern	Central	Southwestern
Ridge top	9	63	60
Ridge side	3	0	0
Alluvial fan	0	26	29
Valley bottom	89	11	11

Table 13. Percent slope used by mountain plovers at the Northeastern (N=141), Central (N=230), and Southwestern (N=70) Montana study areas from 1991-97. Figures are percent of observations.

% Slope	Northeastern	Central	Southwestern
< 5	98	99	96
5-10	2	1	4

Relationship to Grazing

Mountain plovers showed a preference for areas which had been grazed. Overall, 65% of the mountain plover observations were at sites which showed obvious signs of recent livestock grazing. Livestock did not have to be present for a grazed site to be used by mountain plovers. Only 39% of the mountain plover observations had livestock present in a pasture at the time of the observation. Past grazing (primarily during winter and spring) seemed to create conditions sought out by mountain plovers. Sheep were found in pastures used by mountain plovers in 10% of the observations and cattle were found at sites used by mountain plovers in 26% of the observations. However, sheep were found only in the Central study area while cattle occurred in all areas. The majority (83%) of the mountain plover observations in the Central study area were at sites grazed by livestock. At the Northeastern and Southwestern study areas, 49 and 35%, respectively, of the observations were at sites grazed by livestock.

Mountain plovers were also observed in pastures used by bison (8) horses (4) and llamas (1). It appeared that intensity of grazing was more important at attracting mountain plovers to an area than species of ungulate grazing the site. We did

observe mountain plovers to forage within cattle and sheep herds and to feed on flies attracted to fresh cattle fecal matter.

Frequently (33%), mountain plovers were found in association with livestock watering sites. Usually such sites were at wells where water was pumped using either wind or electricity. Most of the mountain plover observations at livestock watering sites were in the Central study area (94 of 157 observations). In this study area in 1992, we walked 16 km of transects between windmills known to be used by mountain plovers and observed no mountain plovers in the lightly grazed land between the water sources. Many of the winter and spring pastures used by mountain plovers in this study area did not have obvious water sources. These pastures generally had a barn or shed and tended to be uniformly grazed short. We also had 4 observations of mountain plovers in the Central study area using fence corners which had been heavily grazed by cattle. Three of these observations were at a fence corner used by mountain plovers in 1991, 1992, and 1994.

Initially, 1 of our best areas to observe mountain plovers in the Central study area was on approximately 5 km^2 of intensively grazed (cattle and horses) winter/spring pasture on the Lewis Ranch. In 1992, 18 adult plovers were observed here. Ranch management changed in 1993 and intensive winter/spring grazing stopped. Mountain plovers observed at this site declined each year and by 1997 no plovers were observed here.

The importance of grazing by prairie dogs was illustrated by the near abandonment of a large (400 ha) prairie dog colony on the Fort Belknap Indian Reservation. During our 1983 survey of this colony for black-footed ferrets (*Mustela nigripes*), we recorded 17 mountain plovers here. This colony was surveyed again in June 1996 and no mountain plovers were found at this site. In 1996, prairie dogs occurred as scattered small groups in this colony and the reduction was apparently the result of recreational shooting, but sylvatic plague cannot be entirely ruled out in this decline.

During the 1992 surveys we made note if mountain plovers occurred in the vicinity of old homestead sites, and 32% of the observations in the Central study area were within 200 m of an old homestead. Usually water was available at these sites and livestock loafed around the old buildings and corrals. However, livestock and mountain plovers could be found at homestead sites without flowing water. Much of the land used by mountain plovers around the old homesteads had been previously farmed 70 to 80 years ago. The entire Central study area had been heavily homesteaded in the early 1900s and a sign at one old homestead on the Central study area stated that the township once had 130 homesteads. Mountain plovers were also observed near the only old homestead sites at the Northeastern and Southwestern study areas (1 each).

Although black-tailed prairie dogs were not common at any of the major study areas (3 colonies each in the Central and Southwestern study areas - representing about 0.1% of each area),

18% of our observations in these study areas occurred on prairie dog colonies (Table 14). Mountain plovers were recorded at all 3 of the prairie dog colonies in the Southwestern study area and over half of all observations of plovers in this study area were in these colonies. Mountain plovers were documented at 2 of the 3 colonies in the Central study area. The third colony, although it appeared to be situated in a topographically unfavorable site for plovers, apparently had previous use by mountain plovers based on observations by local ranchers knowledgeable of mountain plovers (Janet Lewis, pers. commun.).

Richardson's ground squirrels were common in the Central study area and were frequently found in well established colonies at intensively grazed sites. Obvious Richardson's ground squirrel colonies were present at 26% of the sites where mountain plovers were observed at in the Central study area. At present, we have no indication that ground squirrels create vegetative conditions selected for by mountain plovers, but rather it is probably a situation where mountain plovers and ground squirrels are each selecting for similar habitat.

Richardson's ground squirrels were also present in the Northeastern and Southwestern study areas. However, their distribution at these 2 study areas was highly scattered and no well-established colonies were found. Richardson's ground squirrels were abundant at the Toole County mountain plover observation site and they occurred at the Teton County site as well. The Southwestern study area also had Columbian ground squirrels (*Spermophilus columbianus*) present in some areas but usually the sites occupied by this species were not suitable for mountain plovers.

Table 14. Percent of observations of mountain plovers at the Northeastern (N=141), Central (N=230), and Southwestern (N=70) Montana study areas occurring in prairie dog colonies and obvious Richardson's ground squirrel colonies from 1991-97.

	Northeastern	Central	Southwestern
Prairie dogs	0	6	63
Ground squirrels	0	26	1

Activity

A plot of all mountain plover observations by hour shows that mountain plovers were observed throughout the day (Figure 6). The frequency of observations appears bimodal with observations peaking during mid-morning and late afternoon. This bimodal distribution may be exaggerated because we did not always start and end our surveys exactly at sunrise or sunset, and we frequently took a break from surveys at mid-day. However, we did

see examples of plovers resting and using shade provided by small shrubs or bunch grasses during hot afternoons. Presumably plovers would be harder to spot when inactive.

The most frequently observed activity for mountain plovers was feeding (Table 15). All other activities were relatively minor. Most of the displays we recorded were distraction displays of adult birds with young chicks disturbed by our approach.

Table 15. Activities recorded for 431 observations of mountain plovers for all Montana study areas combined from 1991-97.

Activity	% of observations
Feeding	54
Flying	7
Traveling	7
Displays	10
Standing	4
Resting	7
Calling	5
Preening	2
Incubating eggs	2
Brooding young	<1

CONSERVATION CONSIDERATIONS

Across its range in Montana, the mountain plover displays adaptability to a great variation in use of habitat types and topographic situations. The mountain plover is capable of using grassland and dwarf shrub habitats, and is found from mountain benches, to rolling upland prairie, to desert-like silty overflow sites. Annual precipitation at sites used by the nine mountain plover populations ranges from about 25-35 cm (Ross and Hunter 1976). The unifying feature among sites used by mountain plovers is extremely short vegetation (<10 cm), a high percentage of bare soil and lichens (>50%), and extensive (0.5-1 km diameter) areas of nearly level terrain. In addition, persistence of mountain plover populations requires that multiple suitable sites be widely spaced over approximately 25 km^2 area as a minimum. During their daily activity, mountain plovers may utilize seemingly atypical habitat but overall their activity and breeding success is dependent upon habitats meeting the above

criteria.

In Montana, black-tailed prairie dogs within appropriate topographic situations (broad ridges or valleys) can provide mountain plovers with suitable habitat conditions (Knowles et al 1982, Knowles and Knowles 1984, and this study). There should be no surprise that Montana's major mountain plover population corresponds to Montana's major prairie dog complex in Phillips and Blaine Counties. In this area, 18-53% of the prairie dog colonies are suitable mountain plover habitat (Knowles and Knowles 1984) . However, surveys around Montana have demonstrated that prairie dog colonies located within narrow valleys or on narrow ridges are not used by plovers and that small isolated colonies in appropriate topographic situations are generally not used. During the 1991 surveys only 1 of 60 prairie dog colonies examined resulted in mountain plover observations.

Our surveys have demonstrated that intensive grazing by sheep, cattle, horses, bison, and llamas in appropriate habitat and topographic situations can also provide suitable sites for mountain plovers. Our observations at the three major study areas have repeatedly shown that without livestock grazing mountain plovers will abandoned a site over several years. We have also observed on 1 occasion that a grassland site burned during the fall was used by plovers during the following spring and summer.

Removal of the previous growing season's plant litter appears to be an important prerequisite for plover use of a site. Winter and spring grazing by cattle and sheep appear to accomplish this better than summer grazing. However, year-long occupancy by prairie dogs in combination with domestic ungulate grazing provides mountain plovers with the litter free, low growing vegetation that they require for successful nesting and brood rearing. In rare situations, naturally low producing habitats may be suitable for mountain plover use with only moderate ungulate grazing. The Nuttall's saltbrush and yellow eriogomum habitats in the Little Beaver Creek drainage in Valley County, the Nuttall's saltbrush habitat in Treasure and Carter Counties, and the birdfoot sage habitat in Carbon County south of the Pryor Mountains are examples of this.

During the past 7 years, we have systematically surveyed most areas of Montana where there were either historic or recent reports of mountain plovers. At a minimum, Montana has at least nine distinct areas that mountain plovers still use. Significant numbers of plovers occur in Phillips and Blaine Counties, the Central study area, and Northeastern study area. Mountain plovers occur in lesser numbers in the Southwestern Montana study area, and Treasure, Teton, Toole, Carbon, and Carter Counties. Breeding has been documented in all areas except for the latter two sites. Other small isolated breeding populations may occur in Montana, but it is doubtful that a another significant breeding population exists in Montana. It is apparent that Graul and Webster (1976) vastly over estimated mountain plover numbers (88,400 birds in Montana and Wyoming) and distribution in Montana.

Presettlement and settlement period notes indicate that mountain plovers were widespread in Montana east of the Continental Divide, and in at least some areas it was considered a common bird characteristic of grassland habitats (Coues 1878, McChesney 1879, Silloway 1903, Saunders 1911). Although none of the early naturalists attempted to quantify mountain plover abundance, the general impression is that mountain plovers have declined in abundance during this century (Watts and Eichhorn 1981). Specific areas that we failed to find mountain plovers in during the 1990s but were documented to have plovers during the 1800s early 1900s included the vicinity of Terry, Hardin, Fort Benton, Big Timber, Jordan, Three Forks, Ulm, Big Sandy, and Wildhorse. Some sites presently used by mountain plovers were not identified by early naturalists apparently because they did visit these areas. Interestingly, there are no historical records for mountain plovers in Phillips and Blaine Counties between the Missouri and Milk Rivers; the region that now contains Montana's major plover population.

It is difficult to understand how mountain plover populations persist at isolated sites with low breeding numbers. This situation has been reported by others (Dabbs and Ellison 1997). The ridge west of Fairfield apparently has supported less than 6 plover pairs in relative isolation since agricultural conversion of the surrounding area occurred during the 1920s and 1930s. It is possible that our survey effort only finds a small portion of the breeding population and that many other birds are present in the area. Another explanation for population persistence is that plovers arriving in Montana during the spring cover large areas searching for suitable nesting habitat, and that mountain plovers in Montana represent a single large breeding population. Whatever the case, conservation of these small plover groups is probably very important to maintaining plovers in Montana over the long term.

During our surveys, we have looked at many fallow wheat fields for mountain plovers and have only a few observations of plovers in wheat fields. Moreover, these birds were known to use adjacent grasslands. Knowles and Knowles (1984), reported a single observation of mountain plovers using a fallow wheatfield. Shackford (1997) reported one observation of a plover in a fallow field near Moccasin, Montana during a systematic survey agricultural fields across the Great Plains in 1995. We have subsequently surveyed this site and not found mountain plovers. Montana contains about 6 million hectares of dryland agriculture (Stringer and Lund 1997) and this conversion of grasslands to agricultural crops has not benefited mountain plovers. Most of the areas cited above that mountain plovers formerly inhabited but are now no longer found at, are intensively farmed.

Frequently habitat fragmentation and habitat degradation can contribute to extinction of local plant and animal populations, and they are considered the two most important causes of contemporary extinctions (Groombridge 1992). Loss and fragmentation of habitat reduces population sizes and increases

the probability of extinction by demographic and environmental stochasticity. It is generally accepted that loss of habitat has greater negative population consequences than simply fragmenting the habitat (Fahrig 1997). These two processes reduce population size and reduce the exchange of individuals among nearby populations. The decrease in population size and increase in isolation results in a higher probability of extinction by random demographic and environmental events. Species such as the mountain plover with high mobility and dispersal potential may be at lower risk of local extinction than many other species and may account for the presence of populations seeming too small to maintain population viability. However, there can be little question that there has been a substantial loss of suitable mountain plover habitat in Montana during this century, and that many of the Montana mountain plover sites are now separated by long distances. Habitat loss has resulted from agricultural conversion of grasslands, prairie dog eradication and sylvatic plague in prairie dogs.

Our surveys have shown that it is possible to manage for mountain plovers. However, management for plovers probably only has significance where mountain plover populations already exist. During our surveys, we have found apparently suitable sites without plovers, but the sites are too far removed from existing populations to be used. The following is a list of management practices which would favor reproductive success of mountain plovers: 1) Encourage the growth or maintenance of black-tailed prairie dog colonies, 2) Encourage the intensive grazing of cattle, sheep or other large ungulates, especially during winter and spring, in areas with large expanses of nearly level terrain, and 3) Prescribed burning during fall, winter or early spring in areas with large expanses of nearly level terrain. Conversely, prairie dog eradication, carefully regulated summer grazing of cattle, and agricultural conversion of rangelands all appear to be detrimental to mountain plover conservation.

Prescribed burning in the Pawnee and Comanche National Grasslands appears to be a successful tool to providing suitable breeding habitat for mountain plovers (Ball 1997, Kaczmareck 1997). Restoration of prairie dogs to abandoned colonies formerly used by mountain plovers is currently being evaluated in Montana (Dullum and Durbian 1997, Knowles and Weggenman 1998).

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Mountain Plover Survey Sites- Valley County

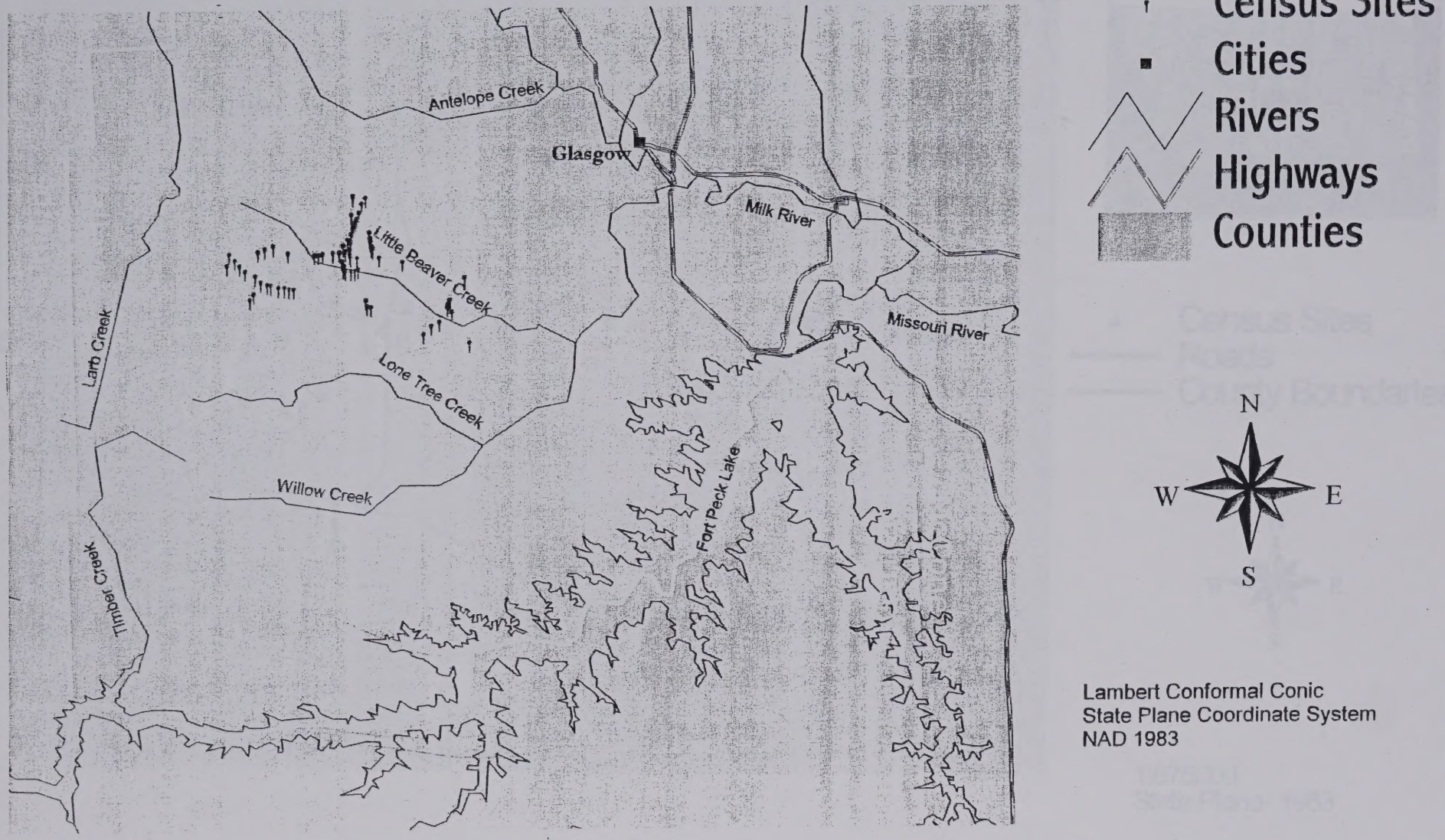


Figure 1. Map of the northeastern Montana study area showing the location of permanent census station sites. These station locations reflect the observed mountain plover distribution from 1991-1997.

Central Montana Mountain Plover Census Sites

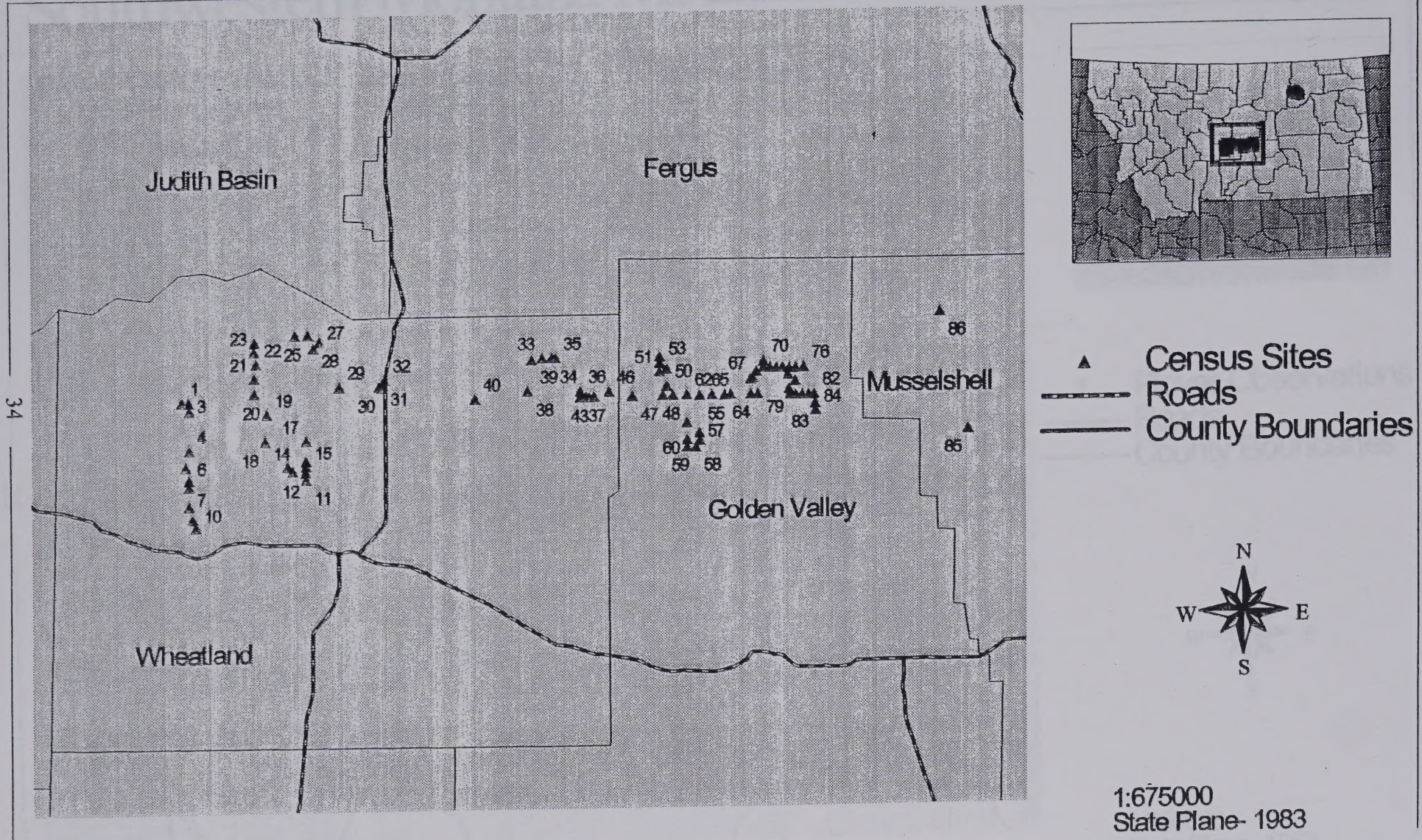


Figure 2. Map of the central Montana study area showing the location of permanent census station sites. These station locations reflect the observed mountain plover distribution from 1991-1997.

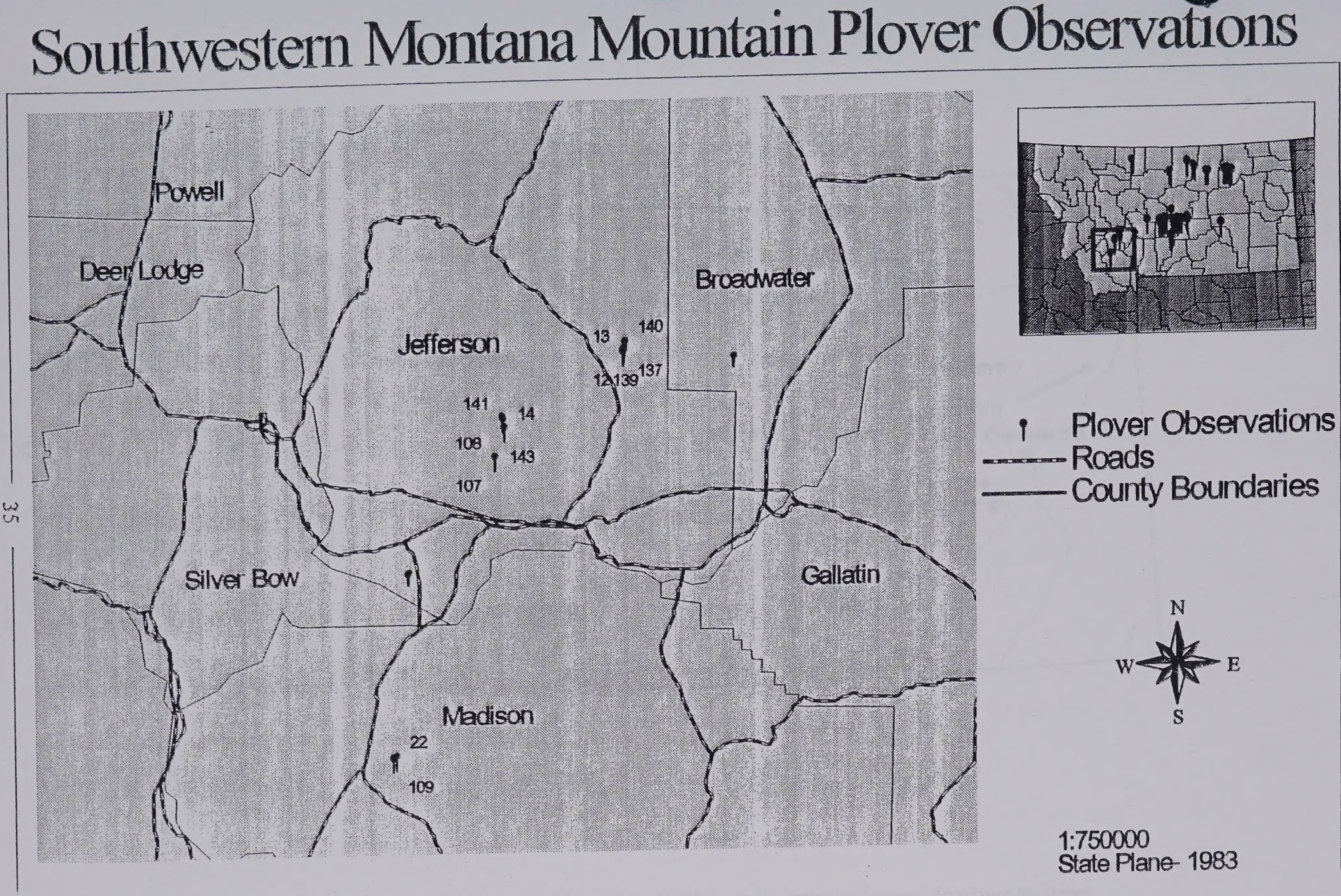


Figure 3. Map of the southwestern Montana study area showing the location of sites used by mountain plovers and permanent census station sites.

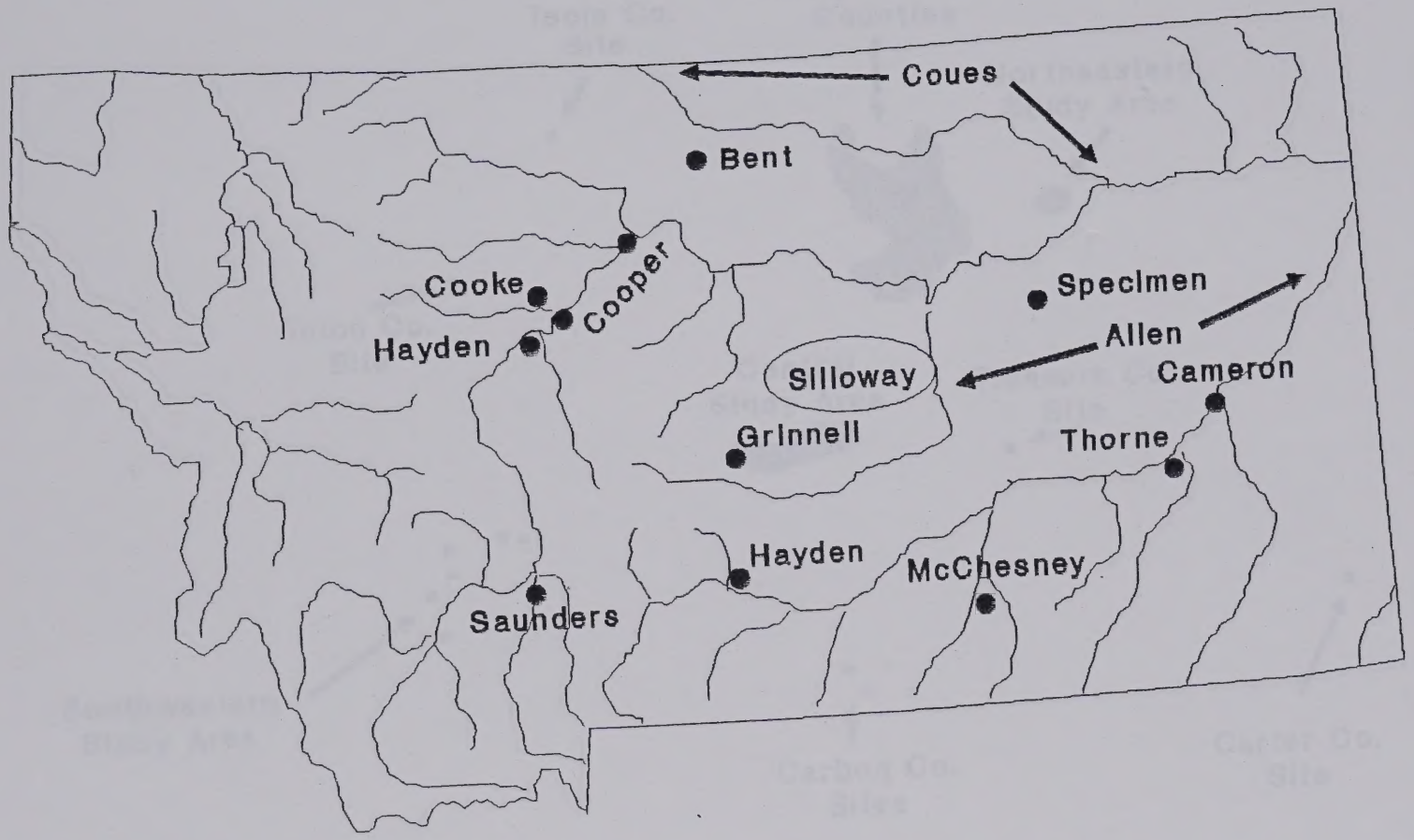
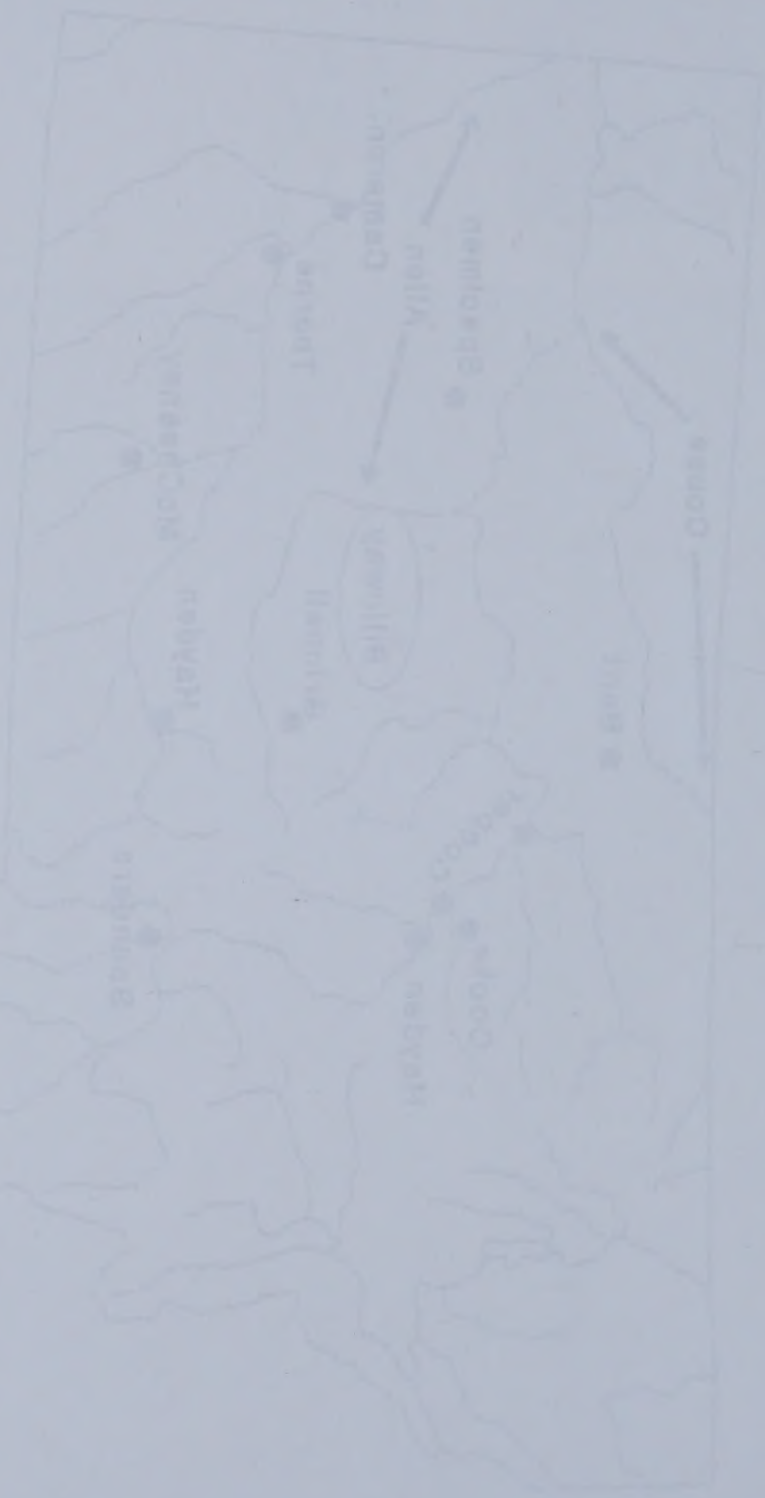


Figure 4. Map of Montana showing the areas surveyed by early naturalists and locations of mountain plover sightings.



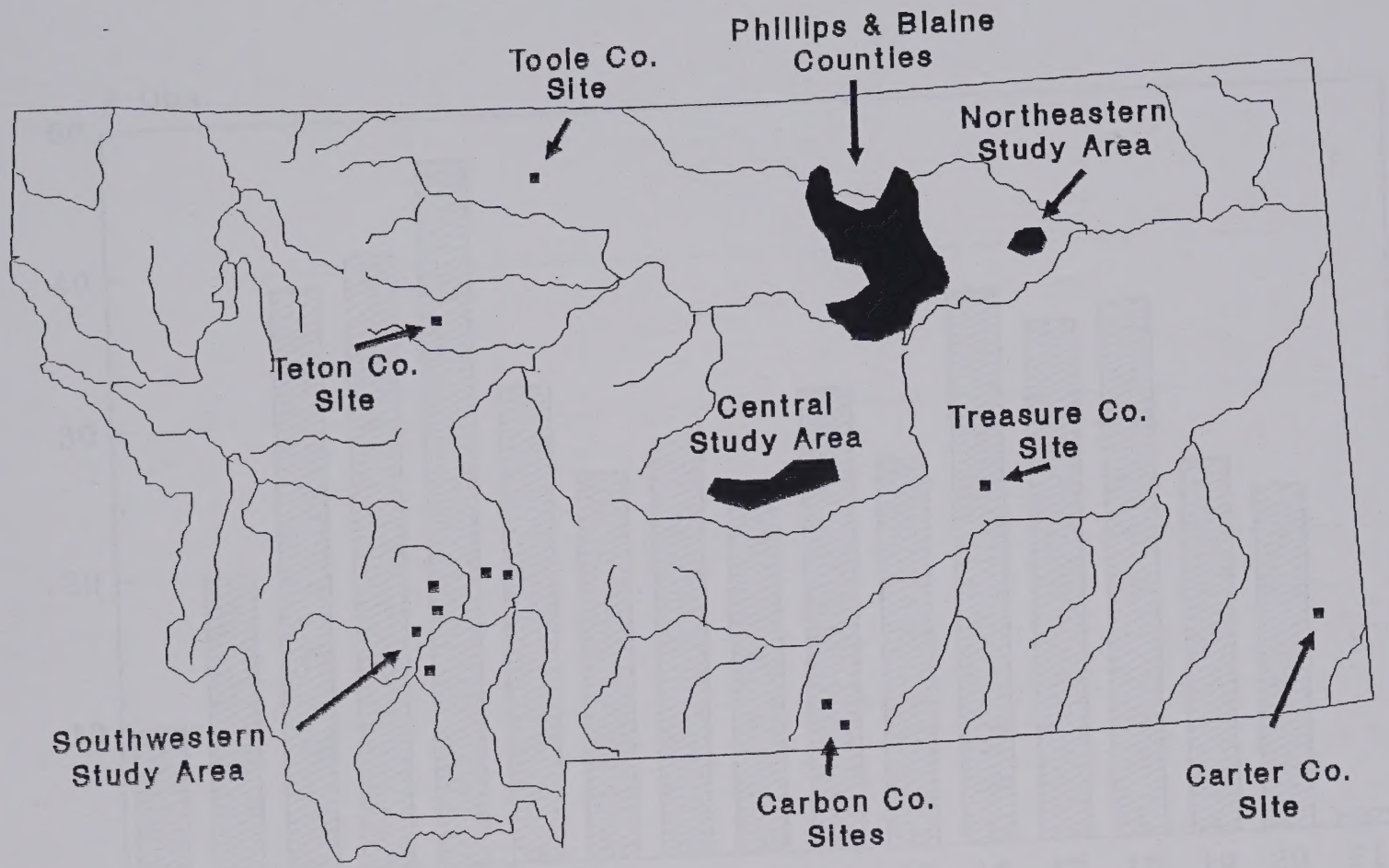
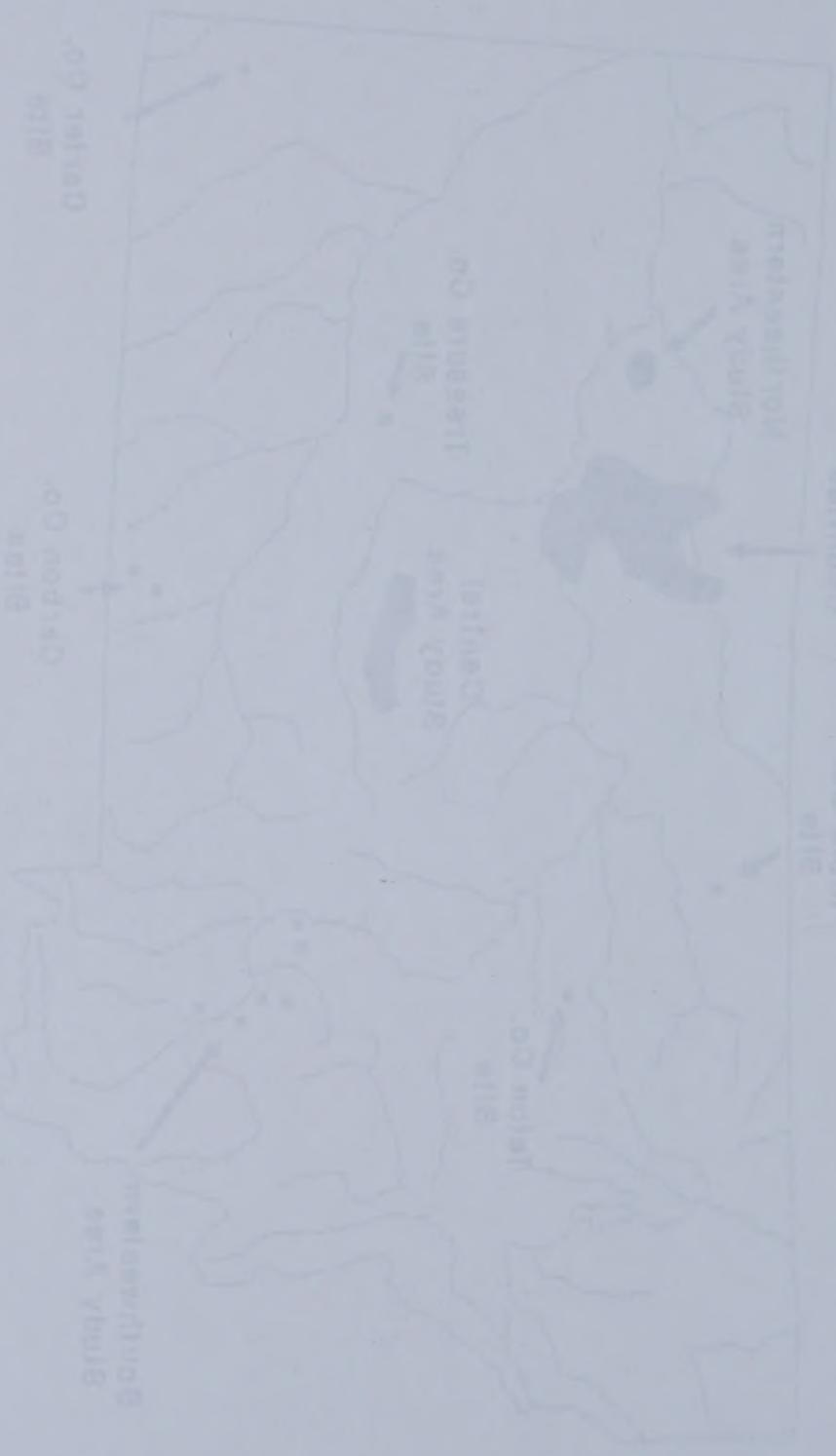


Figure 5. Map of Montana showing the known current distribution of mountain plovers.



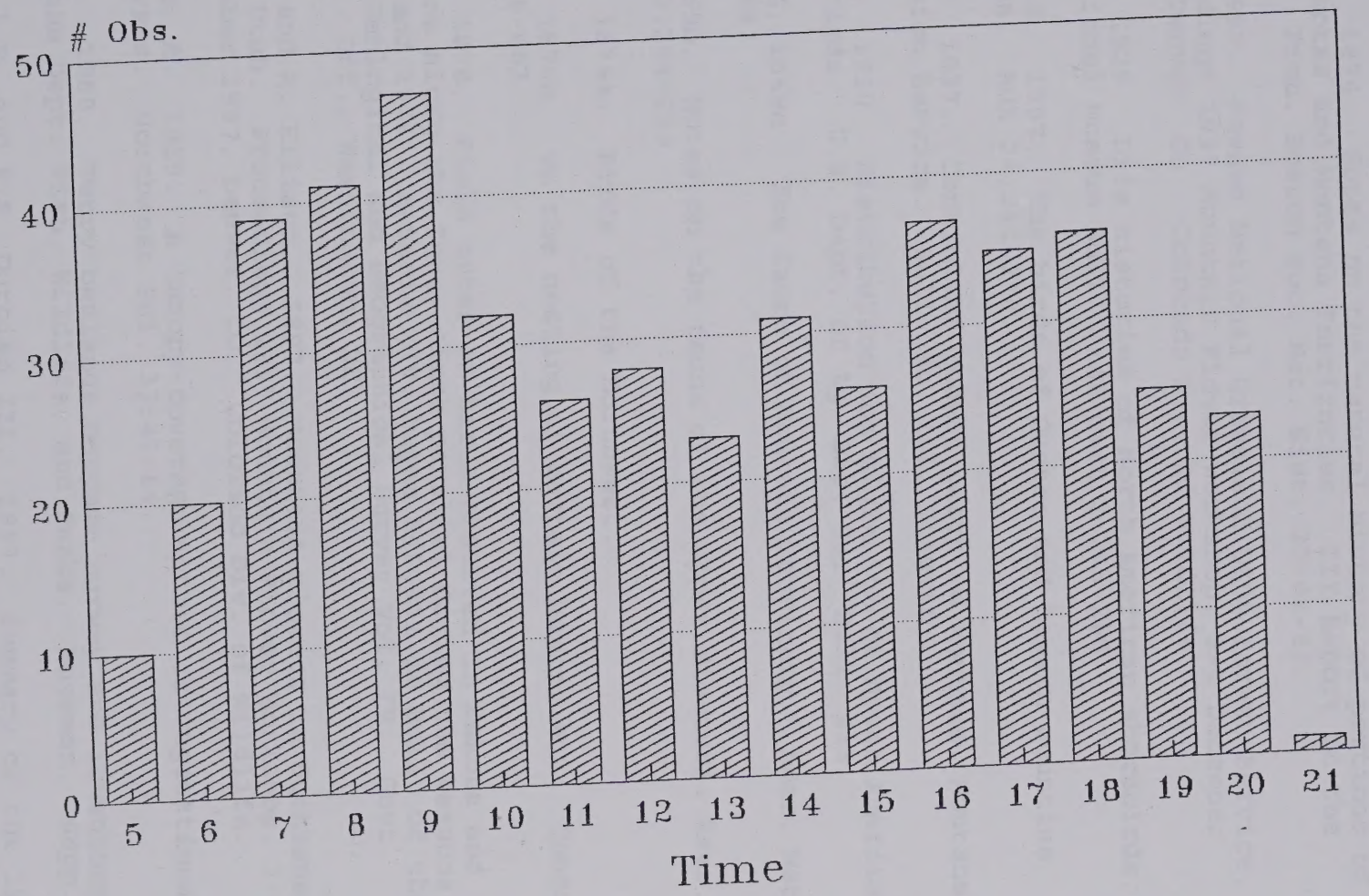
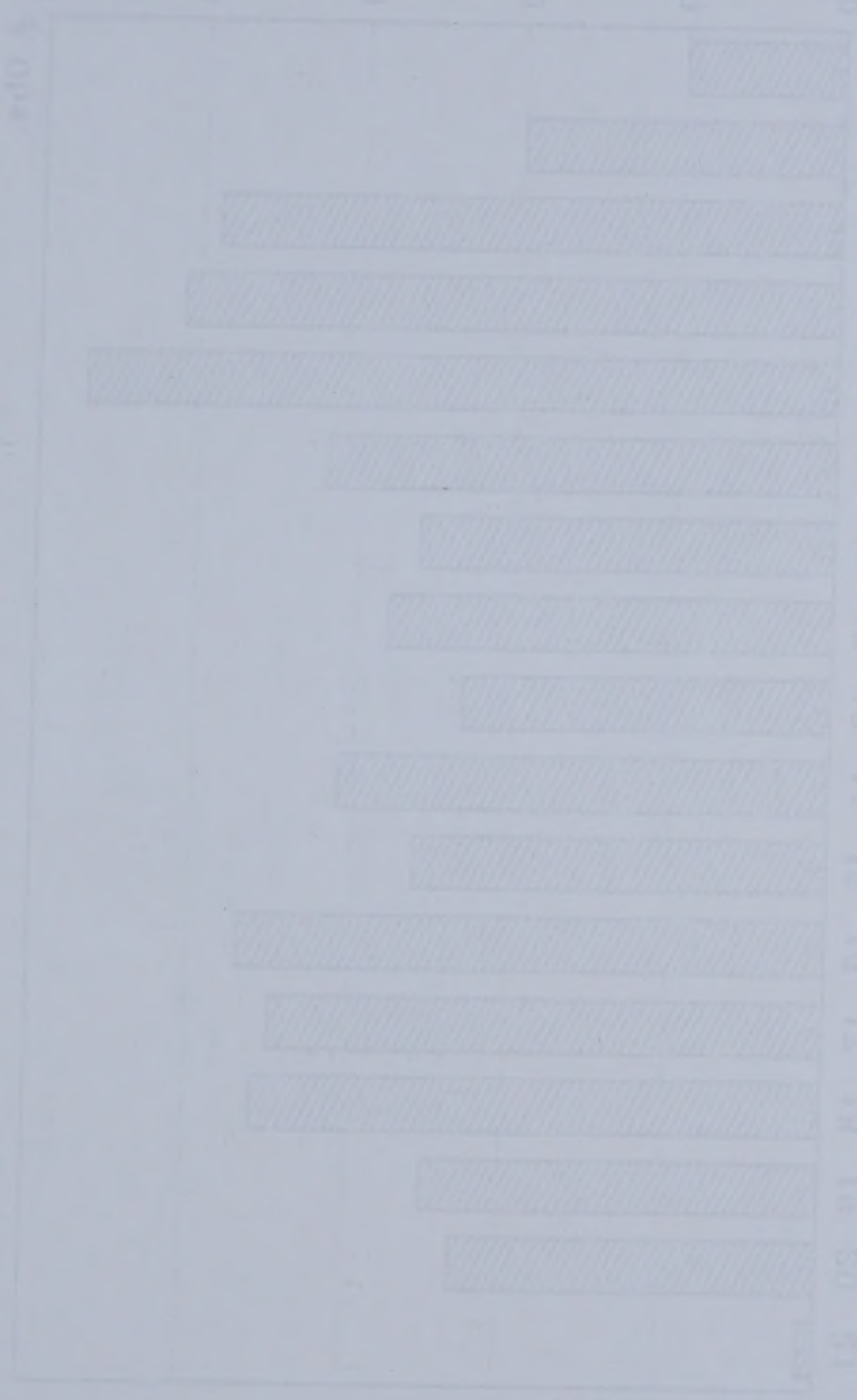


Figure 6. Distribution of 480 mountain plover observations by hour (MDT).



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